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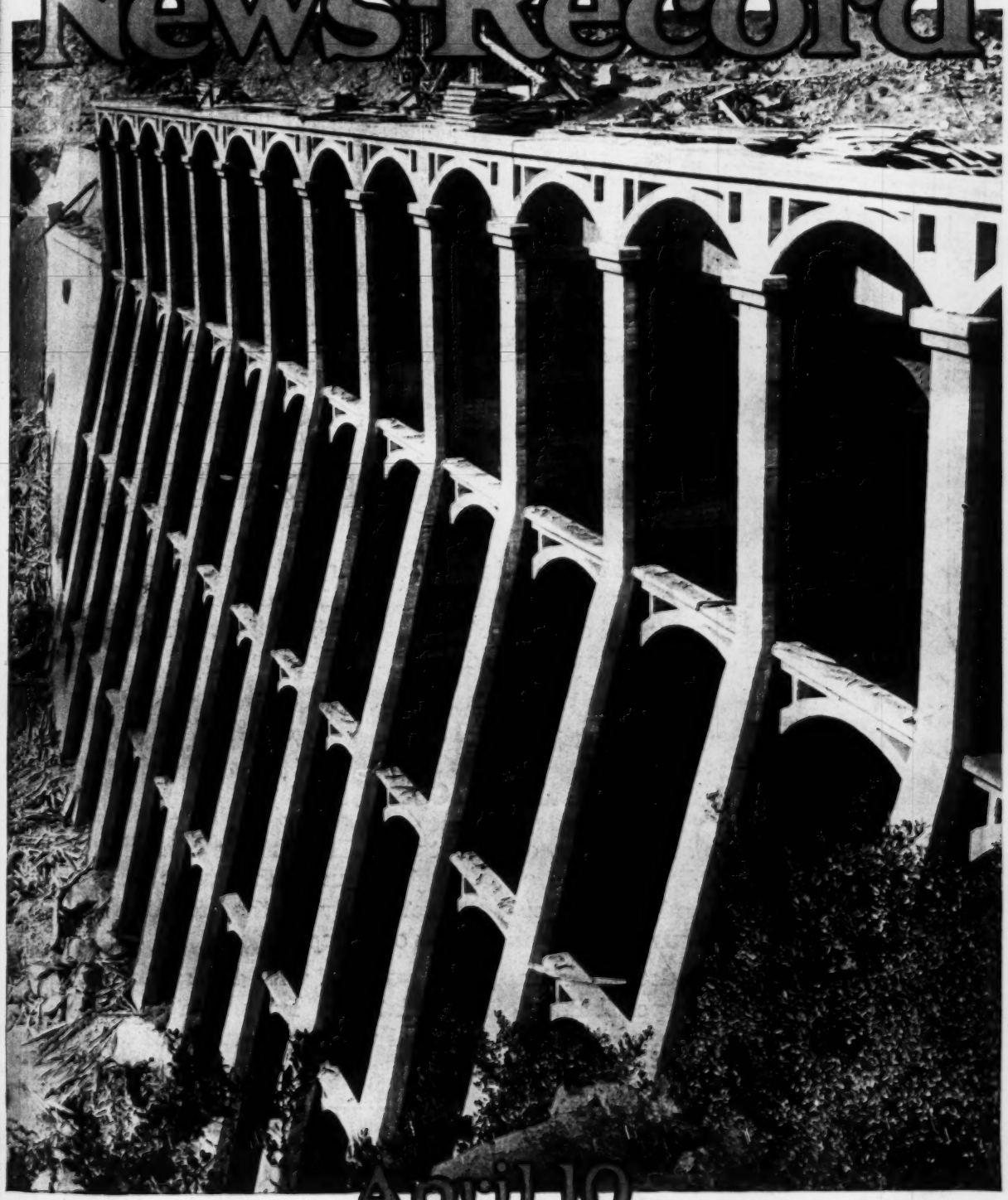

April 10
1919

Timber Construction at a Port Terminal

By HUNLEY ABBOTT

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By F. R. SWEENY

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A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, Editor — CHARLES WHITING BAKER, Consulting Editor

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Society Considers State Legislation

ENGINEERS' meetings to discuss public affairs are sufficiently rare to warrant calling attention to a recent meeting held by the Western Society of Engineers for the purpose of informing its members as to various measures now before the state legislature. The main purpose was to arouse engineers to a broader sense of their responsibilities and opportunities as citizens. Several phases of the general subject were illustrated by a review of bills affecting engineers and engineering work. There were talks by a state senator, the engineer of a public service commission, an architect and the secretary of a civic organization. It is worth noting that the attendance was larger than at many of the meetings when technical subjects are presented. There is a wide field for activity along such lines, and it is to be hoped that the society will take further steps in this direction—including both city and state legislation—and that other societies will follow its example.

Interest in Future of Civil Engineers' Society

IT WOULD be erroneous to interpret the failure of the members of the American Society of Civil Engineers to express themselves freely to the Development Committee, commented upon recently in these pages, as evidence of a lack of interest in the society's future. Wherever two members are gathered together, particularly in the Middle and Far West, there society activities come under discussion. The interest is intense; nor is it a birth of yesterday nor of last year. For a long time the demand for activity has been growing, and that demand has become tempered with impatience because of the inaction. Nevertheless, human nature is the same in the civil engineer as in other members of society. We all have opinions and express them freely to our friends, but we communicate them to the press or to official bodies only on request or when the situation is of a nature that makes it impossible to withhold comment. The views are existent. They are receiving constant expression man to man. The bringing of them to light is but a problem of proper stimulation or of providing the proper forum.

Efficiency and Low Cost In American Shipbuilding

BELATED references to shipbuilding costs are found in the report made by Edward N. Hurley on his European trip in behalf of the Shipping Board. Until this document appeared, two weeks ago, the Emergency Fleet Corporation and its parent, the Shipping Board, published no cost figures save for a few general statements before Congressional committees. However, what Chairman Hurley now says about the cost of shipbuilding is much less important in its specific data than in its strong assertion of his conviction that we can build as cheaply as foreign shipyards. Not only as cheaply, he intimates, but even more cheaply if we will further increase our efficiency. This is a conviction that needs to be emphasized more and more, and supported in thorough fashion by facts and reasons. It is necessary to get all cost-pessimism out of the shipyard. Some of our best yard managers are victims of the belief that shipyards abroad—anywhere—are predestined to build ships more cheaply than we can. Such a conviction paralyzes shipyard effort. Knowledge and study of costs can remove it.

Overtime Work Decreases Efficiency

OVERTIME is so seldom named in listing the influences which tend to reduce the efficiency of labor in construction that its indictment by J. B. Lippincott in *Engineering News-Record* of Mar. 27, 1919, p. 605, deserves comment. Many causes led to low labor efficiency in our recent war construction, but some very shrewd observers have asserted that none was more potent than the wholesale indulgence in overtime work. Besides the normal reduction in output of 25 to 50% expected of men in overtime hours, greed for large pay, due to knowledge that overtime was encouraged, decreased output in straight-time hours. It is the merit of Mr. Lippincott's article that in some measure it evaluates this effect instead of expressing it in general terms. Overtime work as a practice is one of the most vicious sins into which the construction manager can fall. If others who, like Mr. Lippincott, have close knowledge of war construction, would in a similarly exact manner recite the lesson of experience with overtime, they would help greatly in clearing up the confusion which now exists. In particular, they would help to free the cost-plus contract from the criticism made by many, who know it only as a war measure, that it encourages workmen to loaf and shirk.

New York City Starts Sewage-Treatment Program

WHAT may be regarded as a beginning of a sewage-treatment program for New York City was described on p. 674 of our last issue. We do not mean that fine screens are sure to be adopted at each of the numerous treatment works that the peculiar topography of New York City seems to require, but merely that a start has been made in accordance with the general principles deduced from the long and detailed studies of the Metropolitan Sewerage Commission. The earlier fine screens at the Brooklyn sewage experiment station should not be overlooked, but they seem to be in a different class

from those at Dyckman St., which, with the grit chamber, compose the first plant built to treat Manhattan sewage and perhaps may be regarded as the first permanent modern plant for the city. Inasmuch as fine screens have some decided advantages for New York conditions, and since data for this type, as applied to American sewage, are few and not readily comparable, it is to be hoped that thoroughgoing scientific observations on the Dyckman St. screens, yielding both physical and financial unit-volume data, will be made. If New York City would lead the way some at least of the other cities using fine screens might be expected to follow—to the advantage of both New York and the country at large.

Advancing Views on Railway Labor Relations

CHANGING labor conditions are keenly appreciated by railway engineers. Track labor, drawn from the very lowest strata of the unskilled-labor supply, has in the past been treated with a thoroughgoing neglect of its human aspects. But in the light of the new labor conditions that have arisen since we took up arms two years ago, it is coming to be understood that efficiency no less than human justice calls for a different attitude. More consideration must be given to the human element, said a speaker at the recent meeting of the American Railway Engineering Association. He demanded that railway men work ahead toward the future demands of a public sentiment, rapidly developing not only here but all over the world. And the succeeding speaker, emphatically confirming this view, stated, "There has been more progress made by the railroads of this country in handling and caring for their common labor during the past year, I think, than in ten years before." He asked for further careful attention to the matter during the coming year. The speakers were seasoned railway men. Their years of experience are warranty that no sudden enthusiasm or impulse of oratory prompted their words, and what they said was but a reflection of general conviction among the men who direct the maintenance of our railways. There is a great promise in these new views. Most hopeful of all is the recognition of the fact that the doctrine of decent treatment of labor rests on sound reasons of efficiency, and that the high-priced laborer may, if properly handled, justify the larger wage paid him by the larger return he yields.

Scenic Highway Location Questions

DISREGARD of attractive scenery is charged against highway engineers by so many persons who influence public opinion that these engineers will do well to consider the subject. In their desire to attain long tangents, uniform grades and simple, easy curves, the improvers of highways have, it is asserted, forced the traveler to ride in cuts between banks which shut off picturesque views that are famous, and have compelled him to turn away from old, winding roads which offered beautiful scenes worth going miles to enjoy. We all know that the conservator of natural scenery detests any innovation that cuts a tree or drains a swamp. Many of us have felt the lash of his criticism even when we planned our improvements to meet his wishes to the best of our ability. He will never be satisfied; no specialist in artistic matters ever is satisfied But that is no reason why we should not do our utmost to assist the traveler to all the enjoyment of nature's charms, while doing our engineering duty of making his way smooth. The road located on paper may have the best grades and curves and the best balancing of cuts and fills, but when the line is finally run out on the ground and it is found that changes in it will certainly add to the pleasure of the traveler, those changes should receive very thoughtful consideration before they are rejected. Any other course wastes a natural asset and deprives the traveler of the best kind of enjoyment, without accomplishing any good.

Utilitarian and Scenic Need Not Be in Conflict

OBVIOUSLY, the point of view expressed in the preceding note brings into opposition the respective advocates of the scenic and the utilitarian highway. Between the two, however, there need be no real quarrel. Where roads obviously serve only light traffic and run through a scenic district, greater emphasis can be laid upon the scenic feature. On the other hand, roads carrying heavy traffic through a flat or relatively uninteresting country need give little or no consideration to the scenic features. Only where heavy-traffic roads traverse a scenic district need there be a consideration of the two ideas and a balancing of one against the other. Obviously, common sense will control in the weight to be given to each factor. A point that needs emphasis, however, is that oftentimes the utilitarian purpose can be as well served by an interesting as by a dull road.

Pipe-Casing Job Furnishes Lesson in Co-ordination

COÖRDINATION of operations is absolutely essential in certain kinds of construction if reasonably economical results are to be secured. Road building is one of these kinds. A more unusual and also a more extreme example is the concrete casing of pipe lines. The linear extension of construction operations is great, and the volume of construction at any point is small. To schedule the performance of working gangs and machines so that each will be in close coördination with all the others, either adjacent or remote, becomes under these conditions an exceedingly complex problem. Its solution must be accomplished, however, if the work is to proceed smoothly and cheaply, and every example of successful solution, like that outlined on page 725, is helpful in perfecting procedure.

The necessary requirements for coördination on construction work of the kind being considered are: Extreme mobility of equipment, precise scheduling of performance, regular arrival of materials and supplies and prompt repairs of plant. Note how on the Louisiana pipe-line work fulfillment of these requirements was guaranteed. All equipment except mixers could be picked up by hand and carried ahead as fast as the men could walk. Corresponding mobility of mixing plant, which was too heavy for such quick movement, was secured by having two mixers, one of which was traveling ahead while the other was working. Materials supply was separated from the construction operations proper. Also, the detail task of handling and stocking materials on the work was separated from the general task of maintaining and routing deliveries. This subdivision of foremanship was extended to the pipe handling and also to the concreting operations. One concret-

ing foreman had the specific duty of keeping equipment in repair.

Construction seldom furnishes the opportunities which the factory offers for nice subdivision of the duties of foremen or for the application of functional foremanship, but the advantages of both need to be kept in mind by the contractor. The fewer the duties any one foreman has to perform the more precisely, ordinarily, will he perform them. Also, it is more easy to find the man who can perform one task well.

Comprehensive License Laws for Engineers

ENGINEERING license laws are being proposed and passed so rapidly that there is quite evidently no further need for argument to demonstrate the trend of the movement. It is rather only a question of what form the bills will take. The latest bills, abstracted on p. 616 of the issue of March 27 as well as previous bills which were compared in our issue of Feb. 27, 1919, p. 423, indicate the strong tendency toward the adoption of comprehensive laws including all classes of engineering—civil, mechanical, electrical, mining—also, in some cases, land surveyors as a separate and specific class. In the case of the proposed bills in Indiana (which failed to pass the last legislature), Michigan and Ohio, architects are also to be registered with engineers under a single law. The proposed Ohio bill goes so far as to include responsible assistants, even when working under a registered professional engineer or architect, on the plea that the law would be a farce if only the chief engineer of a city or large corporation, for example, need be registered while his many assistants in charge of work are not.

One of the essential features in any sound progress in this movement toward licensing is seen in the provision for specialized examinations. All bills authorize the practice of general engineering, even though separate certificates are granted. This is good practice. The examinations, however, should be devised to test the candidate in two particulars: First, as to his knowledge of fundamental principles underlying all branches of the profession, and second, as to his specific knowledge in the higher technique of his own specialty. Examinations of this type should properly safeguard both the profession and the public, and make the granting of general engineering licenses feasible and logical.

Whether a single comprehensive law to include architects as well as engineers is the best form, depends directly upon whether the architects really desire a law which will not overlap or interfere with any law proposed by the engineers. Aside from the tendency to draw the two professions into closer relation, which would naturally result in their working together for the passage of a common law, there seems to be no valid or convincing reason for bringing both professions under the same machinery of registration.

Whether those states in which surveyors or civil engineers only are now licensed will soon join the movement for more complete protection, as has just been done in Idaho, remains to be seen. In any case, the tendency toward comprehensive licensing bills is certainly strong and should be advanced by all engineers who have faith in the advantages of public recognition and believe in the necessity for greater solidarity in the profession.

Lessons from Professional Organization in England

PROBABLY no discussion of professional organization has had as wide a reading in this country as that which will be accorded to the abstract in this issue of the report by Sidney and Beatrice Webb on professional organization in England. The conditions disclosed bear a striking similarity to those that obtain in this country. On second thought one realizes that such would be the case, for the reasons for class groupings are always fundamental; the variations, therefore, are accidental rather than essential.

It will help to emphasize the applicability of the Webb findings to conditions in this country if we visualize the drama of American engineering society activities. Only a few years ago the four national societies alone occupied the stage, pursuing an even, dignified technical course. The next actors to appear were the local engineering societies, content for a while to play a relatively important rôle, but having a tremendous reserve of suppressed virility. Closely following were the sections of the national societies, bolder than the parents, becoming more indignant and more articulate as the insensibility of the parents to their needs and desires became apparent. Then entered the American Association of Engineers, young, unhampered by precedent, fearing not to tread where the older societies hesitated. Then came the Engineering Council, erected partly out of a desire to do the broader things demanded by the profession, partly as a means of defense against the swift-moving organizations that threatened to steal a march on the older societies. Last to enter are the unions, enunciating the theory that only by collective bargaining, by combining on demands, can adequate compensation be secured.

Nor are the characters in this drama of engineering organization willing to stand about and pose. Some of them—the older societies—were content formerly with that part. Now the action is swift. The initiative proceeds from the younger members of the cast—the locals, the sections and the A. A. E. The older societies are plainly on the defensive. Moreover, their weapon of defense, the Engineering Council, is itself in difficulties. The progressive elements damn it as too conservative and unrepresentative; the conservatives contend that it is too progressive; they question its budget, one of them has refused to appropriate the amount the council requested for the National Service Committee. The locals, meanwhile, in a corner by themselves, earnestly debate national problems and seek a mechanism for united action, while here and there are voices shouting for the submergence of all elements of differentiation and the formation of a single society for the whole profession.

But the action does not end there. Someone raises the question of licensing, and immediately there is a new hubbub, though shortly those demanding licensing prevail. However, in the wrangle the justifying argument has been changed from "protection of the public" to "the advantages to be derived from having a legal status."

The plot now becomes deeply involved. The clear cleavage between groups disappears, as factions split off due now to one issue, now to another, until it is apparent that there is need for someone to come in, to demand a truce, that consideration may be given calmly

to conflicting aims, that through crystal-clear statement harmony may be obtained when harmony is possible. Where the conflict is fundamental, clear statement will enable the dissenting groups to direct their courses more intelligently.

Feeling this need, let the reader turn to the Webb report. He will find there a keen analysis touching on most of the elements of the plot of the drama of American engineering society organization. He will find there the story of a matured conflict between the leaders and the rank and file; he will find union tactics discussed, not as a novelty, but as an abiding feature in even the most eminent of professional organizations; he will find argument justifying a multitude of engineering societies; he will find raised the question of amalgamation versus federation; he will find licensing (or registration, as they call it in England) treated as an essential feature of professional-society activity; he will find, above all, an insistent emphasis upon the need for placing ideals of community service side by side with the present selfish aims of professional societies.

One comes away from the report with the feeling that we are but beginning in the organization of engineers. and that we can modify our society activities very materially without detracting from the standing that we desire them to have. It is a bit of a shock to learn that eminent professional bodies have resorted to union methods. Yet we cannot dodge the advantages to some of such procedure, even as the Webbs do not condemn it.

This much, certainly, the report should do for us—make us more tolerant in the working out of our problems. There is no doubt that the older societies look with deepest apprehension at the growth of the A. A. E. and of the draftsmens' and inspectors' unions. To them, the structure of professional organization seems to be attacked at its very foundation. Yet does not the Webb analysis help us to conclude that the movements are but expressions of the needs of the rank and file, as against those of the leaders of the profession? The A. A. E. is already talking in those very terms, contending that it represents the "employed" engineers, and that the older societies represent the "employing" engineers.

Should we not, too, soften our intolerance of the licensing movement as a result of the Webb analysis· should we not get a clearer view of the ideal of general service, and of the tremendous difficulty of so organizing the profession that all its groups will be articulated?

Certainly we should be directed by the report back to fundamentals. There must be recognition that no power on earth can thwart movements that serve the interests of a large group, however much those interests may depart from our traditional views. Wherever there is a group of goodly size with interests clearly different from those of other groups, there will be found a new movement, a new society. To attempt to destroy it is futile. The part of wisdom is to help it find its place in the whole scheme, fit it in if it can be fitted, letting it work out its specialized problems itself, but in coördination with the interests of the whole profession.

Then should come recognition of the fundamental of conservation of energy—the elimination of duplication. Then the fundamental of efficiency—the recognition that real service lies not in declared intention, but in works, and in works based upon heartfelt sympathy, not on the cold logic of theoretical advantage. For example. as between the Engineering Council and the A. A E., that one will dominate eventually which comes nearer the heart of the greater number in the profession.

If the fundamentals of professional organization are to be summed up in a sentence, we would say that self-interest, the development of technique, and service to the community are the three principles on which it is to be based. the service-to-the-community ideal enlightening the self-interest no less than the ideals of scientific research and development, which have been the important leaven heretofore. If these principles are kept to the front in all discussions of society organization, the difficulties will dissolve themselves more easily and the fitting of the parts into the whole will become a less complex task. Tolerance, too, will help, and to this the Webb report should make no small contribution.

Engineering Standardization—A Problem

A REVOLUTIONARY change in the mechanism of our technical and industrial life was inaugurated during the war period, by the formation of an Engineering Standards Committee, a joint committee of five national engineering societies. The new movement diverges sharply from the established system, under which competent bodies of specialists formulate standards of shape and quality for commercial products involved in technical needs.

The Engineering Standards Committee represents centralized effort in place of logically distributed effort. As a mere piece of centralization it has no special claim to support, for we already have possibly too much unconsidered centralization. But the new organization will stand or fall according to its effect in producing good or bad results. If it will disrupt and rearrange large portions of the present system, built up by several decades of labor and now in full and successful operation, it must show that it will accomplish a net benefit. Up to the present it does not appear to have received much attention, certainly not the wide and careful consideration that it merits. The individual engineer, in fact, has had no opportunity to study it.

Taken up as a war-time measure, when minds were not inclined to weigh the minutiæ of any undertaking that seemed to promise war service, the formation of the Engineering Standards Committee is now to be thought of solely with regard to peace purposes. The new body has produced no results so far. A more active period lies ahead, however. The problems which this coming activity involves are of large scope.

No great movement can succeed, whether in engineering or elsewhere, unless based on a commanding need, and unless planned with care to meet that need. What need will the Engineering Standards Committee meet?

Under present practice standardization is dealt with by bodies obviously competent in the specific subjects dealt with. Natural processes are relied upon to direct the work in proper channels. There is automatic selection of the appropriate tribunals to formulate the various standards, and equally automatic acceptance of well drawn standards. In many years of standardization this process has worked with entire success.

So, for example, the Master Mechanics' and Master Car Builders' Associations deal with uniformity and adequacy in the proportioning of cars and locomotives. Screw threads and fittings and many other subjects have been taken care of by the American Society of Mechanical Engineers. Quality requirements and uni-

form test and acceptance methods for a large range of material are studied to remarkably good effect by the American Society for Testing Materials, and cement-testing methods by the American Society of Civil Engineers. The latter society in the early days, and more recently the American Railway Association, promoted uniformity in rail sections. Bridge design, tie practice, and a host of track details are in the care of the American Railway Engineering Association. Lumber, cast-iron pipe, and other items in very large number are handled by other societies, all competent and recognized as such. So much for organized standardization. But far more important and more constant has been the standardization going on through industrial and commercial processes—as an example, standardization of electric lamp sockets. And one distinct virtue of the system now prevailing is that it avoids all interference with this natural growth of standards.

This complex mechanism has operated in prompt and delicate response to the developing requirements of industry. It has rarely sought to go ahead of these requirements, and has never succeeded in so doing.

What gain will be realized by the new system? This question is primary. No showing of advantage has yet been made, so far as we are aware. There has indeed been talk of conflict between existing organizations, and of failure to coöperate, requiring the firm hand of recognized leadership to bring about harmony. But what are the specific instances? The few cases of recent years in which there has been conflict of authority, or lack of joint consideration, do not, we believe, show a need for controlled coöperation, but contained in each case evidence that the field of work was not yet ripe for effective standardization. But there are further questions to be faced, questions that have not yet been answered; we desire to suggest a few of them.

What are engineering standards? What, in other words, is the field of the new committee? Can it define and delimit its scope, or does it propose to act on the plan of taking over everything resembling standardization work that may come into view? Frankly, we doubt whether the engineers and industrial men of the country are prepared to give a blanket warrant to a new and powerful body to bring about uniformity in any and every subject. Premature standardization is bound to prove confusing, and temporarily fettering to both engineering and industry. And, on the other hand, the delay to proper standardization from adding another element of mechanism may prove equally annoying.

The dangers of a lack of delimitation of scope are obvious, and yet compel scrupulously careful consideration. But it needs to be remembered also that questions of engineering design are often closely interlaced with those of standards, and that, if an unlimited field of action is at hand, mistakes are by no means unlikely, especially at the hands of a body acting by virtue of judicial character rather than competency.

Are we backward in standardizing? With our present mechanism we have taken account of all needs of technical industry as they developed; and standardization may easily run riot if a ponderous machine once gains momentum. Has there been failure to accept standards that have been formulated? Automatic acceptance has been readily accorded on merit to satisfactory standards. Shall we gain through standardization by fiat, by rubber-stamp approval, as a substitute for voluntary acceptance? These are but a few of the many questions surrounding the new movement, questions that address themselves to every member of the profession.

When so many doubts surround the matter, it is surprising indeed that the movement went ahead so smoothly and silently. To look back a few months: It was initiated in the early summer of 1917, with a view to building up an analogue of the British Engineering Standards undertaking, now a dozen or more years old. Whether any regard was had for the fact that conditions here are radically different is not apparent. At the time the first Engineering Standards commission was formed in England there was a deplorable lack of uniformity as well as of means to bring about uniformity. Every mill, for example, rolled different shapes and sizes of I-beams; and this subject was in fact one of the first to be taken up by the commission. Here, on the other hand, an extensive commercial automatic standardization had progressed far, and elaborate society work had long been under way, as already mentioned. These fundamental differences, if noticed, did not discourage the organizers of the American movement, however. After more than a year's work the present committee emerged. It has three representatives from each of the national societies of civil, mechanical, electrical, mining and testing engineers. It is to take control of all existing standardizing bodies, and act not through its competence but by exercising supreme-court judgment on the competency of others.

If representative character is needed to give the authority which this Engineering Standards Committee is to exercise, it has not been realized. Present difficulties surrounding the committee involve this very question, and a reorganization may be brought about. But will even a broadly representative committee or board add authority to a well drafted technical specification by its approval? Will a specification for steel rails, to take a definite example, gain in authority by approval on the part of a body composed of electrical, fire-insurance and boiler experts? This, after all, is one of the inevitable foundation questions, a psychological one rather than one of engineering method.

What we have said is of direct moment, we believe, to engineers in every branch and every society. Two groups of existing organizations, however, are additionally concerned in an even more personal way, as the fields in which they have long worked, with well earned recognition, are now to be gathered into the sphere of the Engineering Standards Committee. The one comprises the technical railway associations, chief among them the American Railway Engineering Association. The other consists of the American Society for Testing Materials. It seems likely that the railway associations will continue their work without thought of the new body, and will maintain their full authority over the matters entrusted to them. With respect to the American Society for Testing Materials, however, the case is otherwise. All its interests, and the peculiarly enthusiastic collaboration of many minds which for years has distinguished its activities, are involved in the risk of a seriously weakening process. No member of the testing society can be indifferent to the developments in connection with the Engineering Standards Committee; nor will any engineer who, though not affiliated with the society, has observed its excellent work, wish to see the new movement proceed if it is to take from the interest concentrated in its committee work, or reduce the service it renders.

Wood Construction Feature of Charleston Port Terminal

Design at Army Supply Base Largely Dictated by War Emergency, But Docks and Warehouses Illustrate Modern Use of Timber for Such Work

By Hunley Abbott
Engineer of Docks, Charleston Port Terminal, Charleston, S. C.

TIMBER construction mainly was used for the docks and warehouses of the Charleston port terminal, an Army supply base on the Cooper River at Charleston, S. C., because timber was the material most readily available for the rapid construction demanded last summer when the work was started. Concrete plans were originally prepared for the docks, but the pressing demand for speed necessitated the change to wood, although some concrete dock work was done after the armistice was signed. The timber details, however, represent the modern use of an old material in harbor structures, and as such are worth describing.

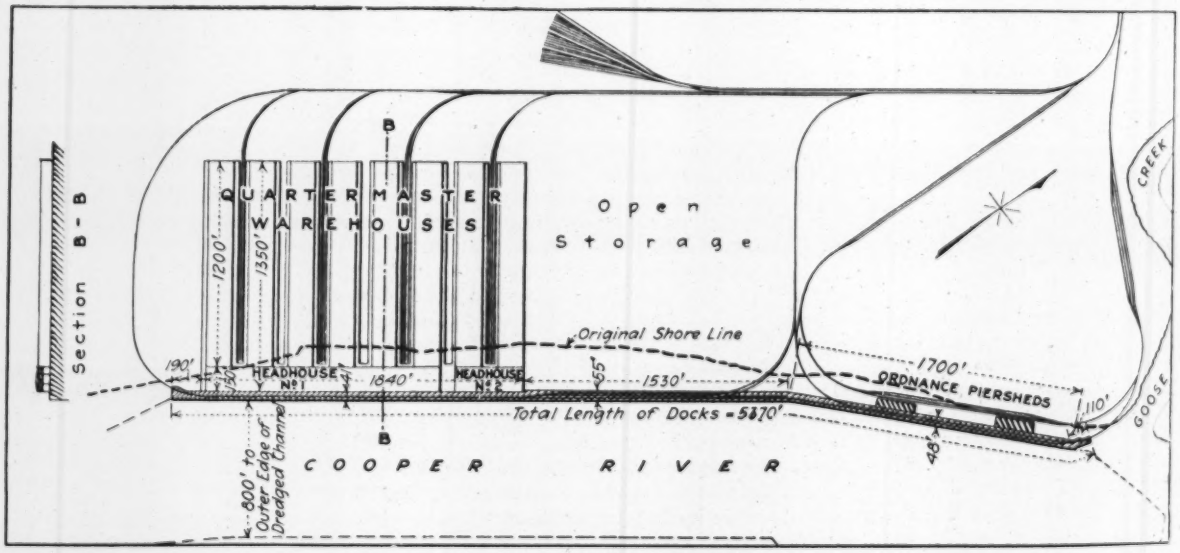
The Charleston port terminal is really three adjoining terminals: (1) A remount station and animal embarkation depot for the empoundment of Army horses and mules and their shipment abroad; (2) an ordnance depot for the storage and shipment overseas of ammunition, powder and TNT, and (3) a quartermaster depot for the storage and shipment of all quartermaster materials. It is only the quartermaster depot which will be described in this article.

The quartermaster depot consists principally of six large warehouses and two large sheds lying parallel to each other and at right angles to the waterfront. Connecting the outshore ends of these buildings are two headhouses, one running along the ends of the six warehouses and the other along the ends of the two sheds. On the outshore side of the headhouses, and connecting therewith, is the dock. The combined floor area of these warehouses and headhouses is 1,700,000 sq.ft. To the north of the warehouses is an open storage area, formed by dredge-filling the marsh, gridironed with tracks and with an available storage space of 1,320,000 sq.ft. Also, there are tanks and water towers, a power house, a locomotive roundhouse, several fire houses, barracks for about 3000 guard, stevedore and other operating troops, an ice plant, a bakery, a hospital and many other miscellaneous structures.

The warehouses and sheds are each 160 ft. wide by 1200 ft. long, with an 80-ft. space between buildings. A 20-ft. platform runs on either side of each warehouse. Three lines of track run down between each pair of warehouses and sheds. These connect with the yard trackage and are used for unloading incoming material. The elevation of these tracks is such as to bring the floor of the car flush with the platforms and warehouse floors, which are at El. 13, zero being mean low tide in the river.

The details of construction of the warehouses follow standard Construction Division practice: Wooden floors, columns spaced 20 ft. on centers and purlins, with tar and gravel roof. The floors are designed for a live load of 500 lb. per square foot. The warehouses, being built on marsh land, rest on pine piles, spaced on 6 ft. 8 in. centers both directions, and which extend above ground and are cut off and capped with 10 x 12-in. floor stringers. The main walls are of tile and brick, and the warehouses are divided transversely every 100 ft. by brick and tile fire walls entirely free of openings, thus dividing the warehouses into a number of fire-insulated compartments. All warehouses are one-story high, except that a second story is built on the lower end of warehouse No. 6 for offices, etc. All openings are provided with fire-resisting doors, and a complete automatic sprinkler system has been installed throughout these buildings, thus providing another safeguard against fire.

The headhouses are 150 ft. wide and have a combined length of 1840 ft. They are of similar construction to the warehouses except that they are considerably



PLAN OF THE TERMINAL END OF THE CHARLESTON ARMY SUPPLY BASE

higher and have a column spacing of 20 x 50 ft. with wooden trusses in the 50-ft. spans. There is a clear height of 20 to 25 ft. from the floor to the under side of trusses. The headhouses are divided into compartments by tile and brick cross walls every 120 ft., and are provided with fire doors and sprinklers, as in the warehouses. All the walls are supported on concrete foundation walls (supported by wooden piles) and the outshore headhouse foundation wall also supports the inshore end of the dock caps.

The columns resting on this outshore wall are of steel instead of wood, and project some 35 ft. above the roof, leaning forward at a slight angle to form a system of cargo masts extending the full length of the quartermaster headhouses. Between the tops of the masts are hung 15-in. I-beams, pin-connected so as to permit the I-beams to swing. Fastened to the web of the I-beam and depending below the lower flange are pin-connected shackles spaced 5 ft. on centers.

Extending along the front of the quartermaster headhouses, north through an open stretch of about 2000 ft., and in front of the two ordnance pier sheds, run the docks, which are slightly over a mile in total length.

The ordnance pier sheds and the quartermaster headhouses are built out in the water and are supported by untreated pine piles. The teredo is very active in the Cooper River even as far upstream as this terminal, consequently it became necessary to protect these piles from attack. This was done by driving wooden sheet piling in front of and returning shoreward to the north and south of the warehouses. Back of this sheeting, under the warehouse floors and surrounding the bearing piles, was pumped a dredged fill to El. 7.5. At this point there is an average tide of 5 ft. in the Cooper River, so this fill protects the piles at all stages of water. The sheet piling is of untreated lumber, and to protect it from the teredo it was originally planned to bank up filled material in front of it and under the dock, allowing it to slope out to deep water at the face of the dock. Owing to the very flat slope assumed by this material, however, and on account of the narrow width of the dock, it was not found possible to pile this fill up to the top of the sheeting without having the toe of it extend far out beyond the face of the dock. Therefore, a triangle of riprap stone was used instead. The depth of water at the sheet piling varied from 8 to 22 ft. Six-inch sheeting was used in the shallower depths, and 12-in. sheeting in the deeper water. The 12-in. sheeting ran 40 ft. in length and was made of 12 x 12-in. Oregon fir with 3 x 4-in. tongue-and-groove strips spiked thereto.

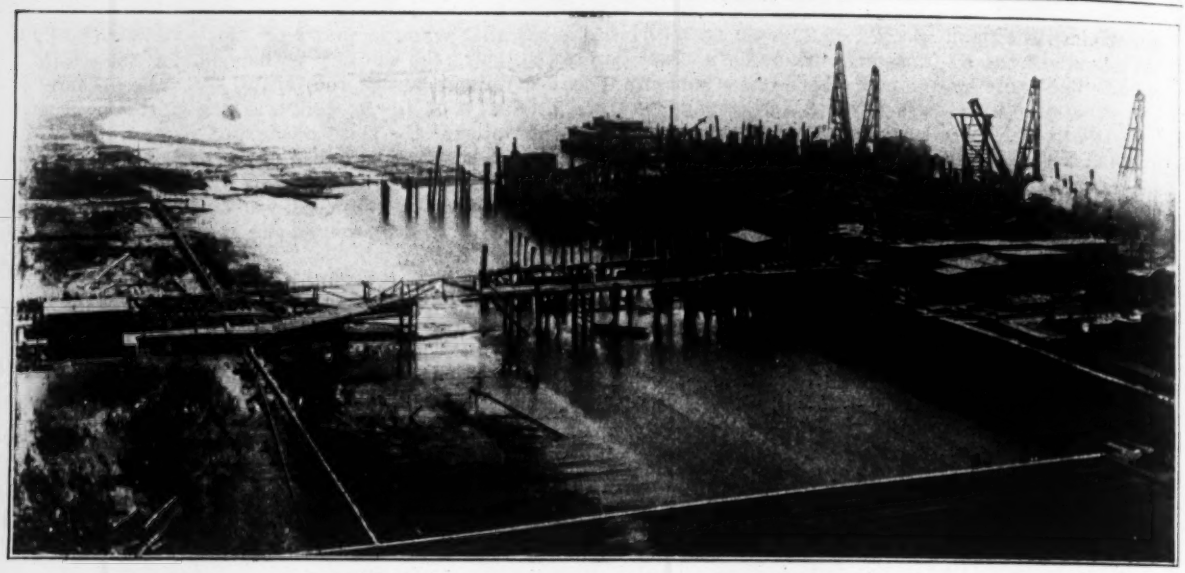
The progress of the work necessitated the placing of the fill behind the sheeting considerably in advance of the receipt of the riprap, and it was, therefore, necessary to brace the sheeting sufficiently to withstand this earth pressure. This was done by tie rods of 1¼-in. diameter, spaced 5 to 6½ ft. apart, passing through 12 x 12-in. wales at the top of the sheeting and tied back into a 12 x 12-in. deadman about 35 ft. in the rear. This deadman rested behind a row of warehouse piles, and two batter piles were driven, one on either side of each vertical pile in this row. The heads of the batter piles were cut with a vertical and horizontal face, the pressure being transferred to the batter piles by the deadman, and the upward reaction of the batter piles being taken care of by 12 x 12-in. chocks bolted to the vertical piles.

Additional resistance was provided by 3 x 10-in. cross-bracing on each row of foundation piles running at right angles to the deadman and extending from the deadman forward toward the sheeting. A cross-section through the 12-in. sheet-pile bulkhead is shown in a drawing. The bracing for the 6-in. sheeting is similar to the 12-in., but only one batter pile is driven at each vertical pile, and the cross-bracing is omitted. There is approximately a half mile of this sheet-pile bulkhead wall in front of the quartermaster and ordnance warehouses.

The original plan of the docks called for an all-concrete construction comprising concrete piles and a reinforced-concrete dock. When the job was very young and only a few of the piles had been cast, it became very evident that the inexperienced labor available here and the inherent nature of this type of construction would prevent the completion of this work in anywhere near schedule time. Since speed was "of the essence," this type of construction was thereupon abandoned, and a creosoted-pile and wooden-deck design was quickly prepared; this is the dock which has been built.

The dock widths vary from 41 ft. in front of the quartermaster warehouses, 55 ft. in the open dock north to a slight angle in the dock, and 48 ft. from there on north in front of the ordnance pier sheds to the north end of the dock, which terminates at the mouth of Goose Creek. The depth of the water along the dock front varied from 10 to 30 ft. This has been dredged to give 30

LOOKING ALONG THE DOCK FRONT OF THE CHARLESTON PORT TERMINAL DURING CONSTRUCTION



DOCK WAS BUILT OUT IN RIVER AND FILLED IN BEHIND LATER

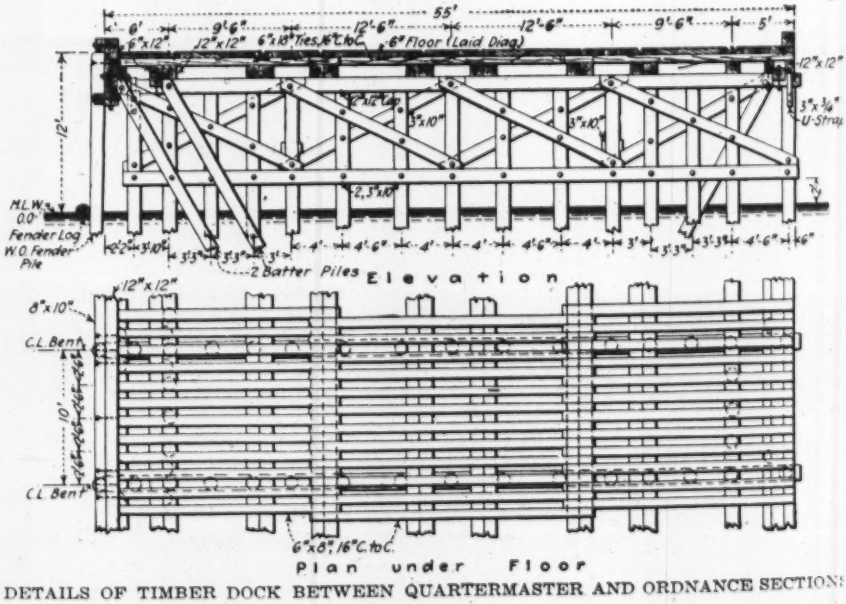
ft. of water below mean low tide throughout the entire length of the docks. A 400-ft. channel was cut from the navy yard up to this terminal, which channel widened out to 800 ft. in front of the quartermaster warehouses and to 1000 ft. in front of the ordnance pier sheds, thus forming a turning basin for ships. The dredged material, consisting mostly of a bluish-green clay, was used to fill in under the warehouses and on other marsh ground along the waterfront. Approximately 2,000,000 cu.yd. of material was moved to cut this channel, several rotating cutter dredges being used.

The docks are designed to carry a live load of 500 lb. per square foot, together with certain railroad and gantry loads. The floor of the dock is at El. 12, with a slight upward slope from face to rear. This floor comes flush with the warehouse floors where the two meet. All piles, except fender piles, are creosoted, the le ıgths varying from 40 to 80 ft. They are driven in bents spaced on 10-ft. centers, and each bent is capped with a continuous stick of 12 x 12-in. Oregon fir, drift-spiked to the piles.

A system of bracing on each bent extends from the cap down to El. 2. Two horizontal 3 x 10-in. timbers are bolted on either side of the piles at that elevation, and 3 x 10-in. cross-bracing runs between these and the pile cap, being bolted to the piles and the cap at intersections. All the bolts are of 1-in. diameter. It was originally planned to use creosoted timber for all this bracing, since it will be under water at high tide. On account of the delay in obtaining this creosoted material, however, untreated pine lumber was used. This will be eaten away in time by the teredo and will have to be replaced, and at the time of replacement creosoted lumber will probably be used.

On those sections of the dock that are in front of warehouses there are two batter piles in front and one in the rear at each bent. In the open sections of the dock there are four batter piles per bent in front and one in rear. The heads of the batter piles are cut so as to have a part horizontal and part vertical face. These faces bear against longitudinal timbers running over the pile caps and bolted thereto. At such point on the cap a 3 x ⅜-in. steel U-strap ties the cap to a vertical pile, thus transmitting the upward reaction of the batter pile through the timbers and cap and down into the vertical pile.

On the dock in front of the quartermaster warehouses there is one line of standard railroad track and two rails spaced 19 ft. apart for a 5-ton gantry crane. On the 55-ft. wide section of the open dock there are three lines of railroad track and rails spaced 44 ft. apart



DETAILS OF TIMBER DOCK BETWEEN QUARTERMASTER AND ORDNANCE SECTIONS

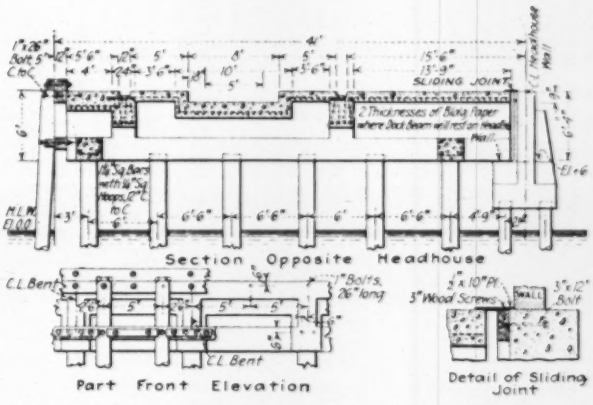
for a 10-ton gantry. Standard 80-lb. rails are used for the gantry tracks, and Russian rails 5 in. high with tie plates for the railroad tracks. Two 12 x 12-in. pine stringers are placed under each rail of the railroad track, and one 12 x 12-in. stringer under each gantry rail. Supporting this gantry stringer are three additional creosoted piles spaced between each bent, thus giving a pile every 2½ ft. under this stringer.

On top of these track stringers are laid 6 x 8-in. cross-ties spaced 16 in. on centers, and these ties also support the 6-in. floor in the neighborhood of the tracks. In places where no tracks occur the flooring is carried by 6 x 12-in. stringers 3 ft. on centers resting on a 6 x 8-in. timber spiked to the top of the cap.

Several heavy timbers are framed in on the face of the dock for stiffness, and a 12 x 12-in. bumping timber projects above the floor at the face of the dock and, in the open sections, in the rear also. White-oak fender piles are spaced on 10-ft. centers in front with an 8 x 12-in. fender cap and a line of 8 x 10-in. fender chocks.

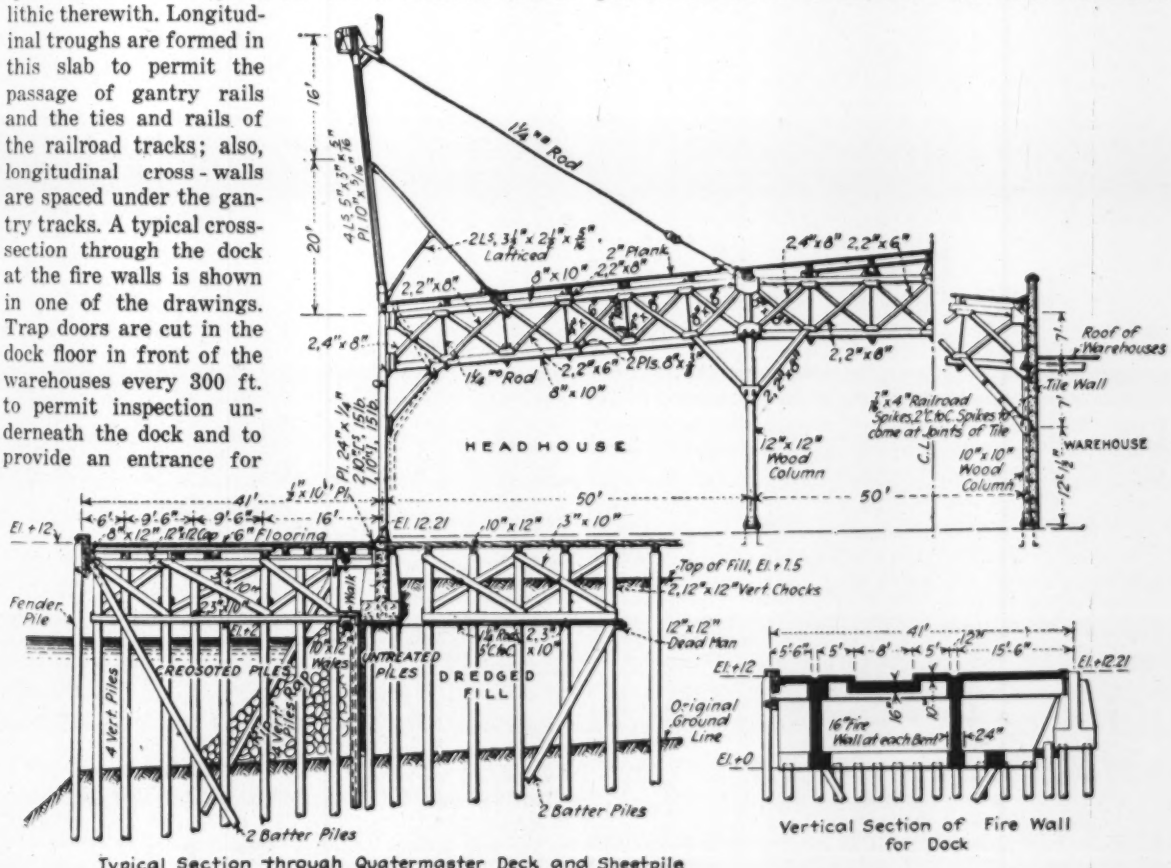
A 3-in. space is left between the rear of the dock and the front wall of the warehouses to allow for any possible movement of the dock when a ship is brought alongside. This slot is covered by a 10 x ½-in. steel plate.

The docks are divided into 300-ft. sections by double fire walls. The piles in two adjoining bents are cut off near low water, and a 16-in. concrete wall is built on each bent. The bottoms of the walls are at mean low water, and are tied together by longitudinal reinforced-concrete struts. A reinforced-concrete deck spans between the tops of the two walls and is monolithic therewith. Longitudinal troughs are formed in this slab to permit the passage of gantry rails and the ties and rails of the railroad tracks; also, longitudinal cross-walls are spaced under the gantry tracks. A typical cross-section through the dock at the fire walls is shown in one of the drawings. Trap doors are cut in the dock floor in front of the warehouses every 300 ft. to permit inspection underneath the dock and to provide an entrance for hose lines in case of fire. Standard types of mooring posts and cleats are spaced every 80 ft. along the outer edge of the dock. A group of dolphin piles was driven at the outshore corner at each end of each dock.



CONCRETE ALTERNATIVE DESIGN OF CHARLESTON DOCK WALL NOW BEING PLACED

When the armistice was signed and speed of construction became less vital, it was decided to use the concrete piles already cast to build 150 ft. of reinforced-concrete dock, in accordance with the first plan. These piles were 52 ft. long and 18 in. square, with beveled corners. The lower 2 ft. of length was tapered to a 6-in. square point. They were reinforced with four 1¼-in. square rods spaced 3 in. from the face of the pile to the center of the rod. The main rods were



DETAILS OF TIMBER DOCK AND HEADHOUSE OF QUARTERMASTER STORES AT CHARLESTON, S. C.

tied together every 12 in. by hoops made of ½-in. steel. These hoops were spaced 4 in. for about 5 ft. at the head, and 3 ft. at the point of the pile. About 4 ft. from the head of the pile a short length of pipe 3 in. in diameter, was cast in the pile at right angles to the axis. This gave a convenient point to which to tie in handling the pile in the driver leads. The piles were cast on large platforms. Wooden forms were used for the piles, with a space of 9 in. between each set of forms, to facilitate stripping. When the concrete was sufficiently set these forms mere removed and were used again to form a pile on top of the previous one. In this way three tiers of piles were cast.

The piles are cut off at El. 6.5 with the pile reinforcing rods projecting 2 ft. about the cutoff, and a heavy concrete girder wall caps each bent of piles. This wall extends up to and is monolithic with a 9-in. reinforced-concrete floor-slab spanning between bents. Heavy girders are cast under the gantry rail, and a trough is left for the railroad track similar to that in the fire-wall construction. Two longitudinal struts brace the bottom of the bent caps, one strut near the front and one near the rear of the dock. A typical cross-section of this concrete dock is shown in one of the drawings.

After the armistice was signed, one of the ordnance pier sheds and the dock in front of it were abandoned; also a portion of the open dock between the quartermaster and the ordnance warehouses was omitted. All of the quartermaster warehouses and headhouses are built, however, together with about a half mile of dock in front of them; also 700 ft. of dock in front of the ordnance pier shed.

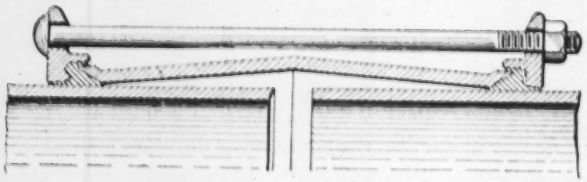
The total cost of this project will be approximately $17,000,000. The work was in charge of the engineering branch of the Construction Division of the Army, under the supervision of Col. Lincoln Bush, Lieut. Col. R. M. White, chief of the Port Terminal Section, and Lieut. Col. L. L. Calvert, supervising constructing quartermaster. Col. F. E. Lamphere was constructing quartermaster in charge of the work in the field. The Mason & Hanger Contracting Co. was the general contractor, and the Degnon Contracting Co. was the subcontractor on the ordnance magazines and part of the docks. The Atlantic, Gulf & Pacific Co. was the contractor for the dredging.

Constructs Largest Gas Line in the United States

Coke Plant Builds Gas Main 40 Inches in Diameter Laid Near Pittsburgh—Method of Construction and Joints Described

CONSTRUCTION of what is reported to be the largest gas line in the United States, and probably in the world, is now being completed for the Carnegie Natural Gas Co. The line has a maximum diameter of 40 in., is 11 miles long, has a daily capacity of 70,000,000 cu.ft., and is capable of sustaining a pressure of 200 lb. per square inch, but will actually work under a pressure of from 30 to 50 lb. It is being built to convey gas from the byproduct coke plant of the Clairton Coke Works to the Duquesne, Homestead, and Edgar Thomson steel mills near Pittsburgh. The joint used is of the Custer type, with rubber gaskets. The flexibility of this joint, due to its buckle-plate sleeve, is said to have made it much easier to obtain tight joints over this rough country, which required many vertical and horizontal curves. This feature also expedited the field work and made it possible to lay the pipe with inexperienced men and at a minimum cost.

Design and Location of Line—The pipe for this line is of the lock-bar type, with plain ends. The uniform thickness, for all sizes from 30 to 40 in., is ⅜ in. Three diameters of pipe are being used, as follows: There are 38,081 ft. of 40-in.; 12,381 ft. of 36-in. and 7881 ft. of 30-in. These reductions in size are made as the line nears its destination, and rear the branches to the various manufacturing works. It was necessary to use riveted pipe in certain special sections for very sharp curves and for a riser which was required at a bridge.

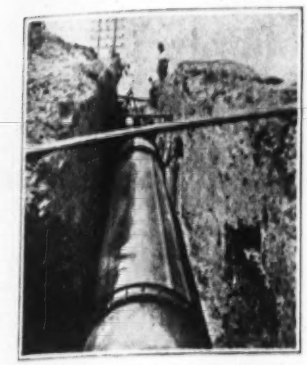


CUSTER COUPLING SHOWING BUCKLE-PLATE SLEEVE AND RUBBER GASKETS

As the line passes through a hilly country, the vertical and horizontal curves are numerous; this required special beveling of the ends of the pipe so that they would fit tightly together. The grades and alignment were carefully worked out, and the pipe for curves were cut and match-marked for assembling. Where the curves are of large radius, the play allowed by the flexible joints used is sufficient to make the turn. The design of this coupling is shown in the sketch. The buckle-plate sleeve which abuts against the rubber gasket allows for an opening of from 1 in. to 1¼ in. on the outside of curves, while still maintaining a gas-tight joint. By proper beveling a curve of 133-ft. radius was laid. To round this curve, which is shown in the illustration, six 17-ft. lengths, beveled 2½ in. each end were used. The central angle of the curve is 44° 3 min. and the tangent length is 54 feet.

ROUNDING SHARP CURVE

Construction—Pipe was delivered at the site by rail, the standard length being 30 ft. It was loaded nine per car for 30-in., eight per car for 36-in., and five per car for 40-in. diameter. Delivery to the line was by teams, as it is has been found by experience that they cannot be equaled for this work, on account of the roughness of the country through which the lines generally run. The pipe can be loaded and unloaded by various means, but the general practice is to snub them down skids from the cars to the wagons, and from the wagons to the ground at the location. Accurate



TRENCH CUT BY EXCAVATOR —PIPE INSTALLED

placing is, of course, conducive to efficiency in laying, and this received particular attention. The pipes were distributed and strung out parallel to the line, as near as possible to the place they would finally occupy. However, where the line ran along a side hill, it was often necessary to lay them at right angles to the line to keep them from rolling. This caused extra expense in laying pipe.

Excavation—The nature of the soil along the line varies from heavy clay to hard rock. A large part of it is clay, and for such sections a specially designed trenching machine which digs a trench 54 in. wide is used. This width of trench will accommodate a 40-in. pipe. Where rock is encountered, a light revolving steam shovel of ¾-cu.yd. capacity, having a long dipper-handle is used. The trench is first drilled and blasted, and then cleaned out by means of the steam shovel. The general depth of the excavation runs from 6 to 8 ft., two feet of covering being considered advisable.

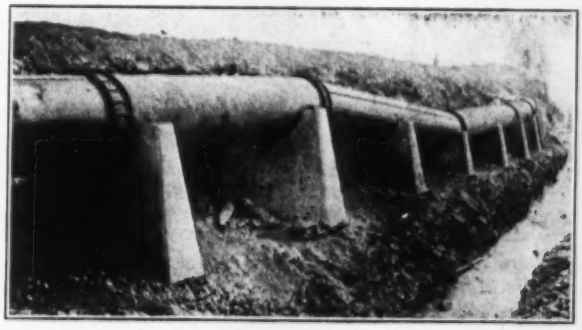
With the trenching machine 500 lin.ft. of trench, from 6 to 8 ft. deep, is excavated in 10 hours. The gang required for this work is an engineer, a fireman and 15 men. These are required to keep the buckets of the excavator from clogging, to keep the track clear for the track-laying tractive device, and to place planking where necessary. A view of the trench cut by the machine, with the pipe installed, is shown in the illustration. In some places, where the ground is unstable, it has been necessary to slope or sheet the sides of the trench.

Pipe Laying and Joining—After the delivery of the pipe, and upon the completion of the trench to the proper line and grade, pipe laying is accomplished by means of tripods supporting block and tackle operated by a winch, as shown in an illustration. After lowering the pipe into the trench and adjusting the joint, the back tripod is moved forward, while the forward tripod supports the end of the pipe until the insertion of the next length. In adjusting the joint the back ring is first put upon the pipe, and the rubber gasket, which fits snugly against the pipe, is snapped over it and pushed back to position in the ring groove. The buckle-plate sleeve is next inserted, after which the next length of pipe, with the forward ring and the rubber gasket already in place, is inserted in the sleeve. The ringbolts are now placed and the nuts tightened up temporarily. A ⅜-in. clearance between the ends of the pipe is allowed for expansion. After temporary placing and tightening of the bolts, an auxiliary gang follows and completes this tightening, which presses the buckle-plate in against the rubber gasket, making an air-tight joint.

LOWERING THE PIPE WITH TRIPODS AND ADJUSTING THE JOINTS FOR TIGHTENING

One foreman and 30 to 35 men lay and completely connect up about 400 ft. of this gas-line per day, including an initial covering with about 1 ft. of earth. Inasmuch as there is no riveting, the work can all be done with ordinary labor under proper supervision.

As soon as a mile of pipe has been laid and the centers have been backfilled, it is subjected to what is known as a soap-and-water test. This consists of sealing the ends of the pipe and going over all field joints with soap and water, so that when the pipe is subjected to the required pressure of 50 lb. per square inch, soap bubbles will appear upon the surface, if there is leakage. The individual sections of pipe receive this test before leaving the shops. This is considered one of the severest tests that can be required of a gas line.



PIPE LAID UPON CONCRETE PIERS WITH 15-FOOT SPAN ALONG EMBANKMENT

Backfilling—Backfilling is accomplished by means of a dragline machine. With a gang of six men about 300 ft. per day is backfilled on the average. It is necessary to dress up the final surface by hand.

Work upon the 48,000-ft. line to the Duquesne and Edgar Thomson steel mills began Oct. 1, 1917, and was completed Aug. 31, 1918. The 12,000-ft. branch to the Homestead steel works is now being completed. The average gang employed upon the work has been 1000 men, who work in several gangs. In special cases the pipe was laid above ground on concrete piers with a span of about 15 ft., as shown in one of the illustrations. Being a gas line, it is unnecessary to keep it covered on account of frost.

The T. A. Gillespie Co., of New York is the contractor for the construction, and the lock-bar pipe is being furnished by the East Jersey Pipe Corporation.

Notes on the Design of a Single-Wall Cofferdam

Size and Location of Timber Wales and Braces and Size of Timber and Steel Sheeting Developed From Both Theoretic and Economic Considerations

By F. R. Sweeny
Engineer, The Foundation Co., Pittsburgh, Penn.

COFFERDAMS are too often built by rule-of-thumb methods, regardless of structural or economic requirements. The following analysis is offered as a practical and ready solution of the design of the most generally used type of cofferdam, the open pit in which the retained earth or water is held by vertical sheet-piles bearing against longitudinal wales and cross-braces. Such a coffer is shown in plan and cross-section in Fig. 1, which also gives the diagram of pressure,

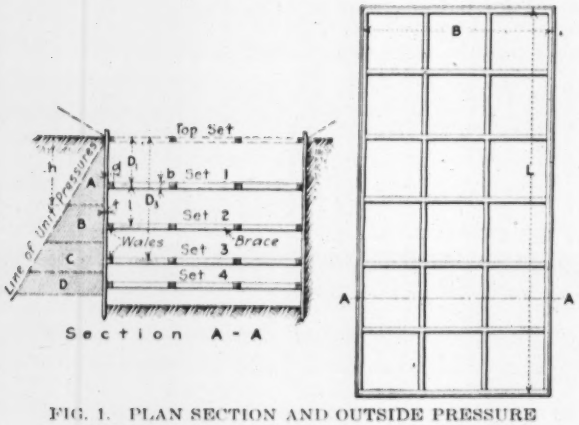


FIG. 1. PLAN SECTION AND OUTSIDE PRESSURE DIAGRAM OF SINGLE-WALL COFFERDAM

assuming that the horizontal unit pressure varies directly as the depth.

Let

w = Weight per cubic foot of material outside sheeting.
c = Ratio of horizontal to vertical pressures.
s = Span of wale in feet.
N = Number of rows of wales from surface (not counting top set).
D_1, D_2, D_N = Distance from surface to corresponding wale.
b = Width of wale as a beam.
d = Depth of wale as a beam.
l = Span of sheeting or distance between wales.
h = Depth from surface to any point.
W = Allowable load on wale of span s and section $b \times d$.
k = Safe unit stress in wale.
b' = Width of single sheeting.

In addition to the above assumptions, let areas A, B, C, and D be equal, which means that all wales are the same size. It follows from these assumptions that the top wale set will be theoretically of zero size, since it is supposed to carry no part of the load from area A. From practical considerations this set is always placed, but it will form no part of these discussions, since, by so doing, the conclusions will in no way be affected. This set is shown dotted.

The total load on N wales over one panel =

$$\frac{1}{2}wch^2s = NW \text{ or } N = \frac{wch^2s}{2W}$$

But since $W = \frac{kbd^2}{9s}$ then

$$N = \frac{4.5wch^2s^2}{kbd^2} \quad (1)$$

$$h = \sqrt{\frac{kbd^2N}{4.5wcs^2}} \quad (2)$$

Equating the moment of the total pressure area, to include N wales, to the sum of the moments of the wale reactions about the surface, we get the following expression,

$$NW \times \frac{2}{3}\sqrt{\frac{kbd^2N}{4.5wcs^2}} = WD_1 + WD_2 + \ldots + WD_N$$

Solving for D_N we get

$$D_N = \frac{2}{3}\sqrt{\frac{kbd^2N^3}{4.5wcs^2}} - (D_1 + D_2 + D_3 + \ldots + D_{(N-1)})$$

Substituting the value of $D_{(N-1)}$

$$D_N = 0.314\frac{d}{s}\sqrt{\frac{kb}{wc}}\left(\sqrt{N^3} - \sqrt{(N-1)^3}\right) \quad (3)$$

Equation (3) expresses the law of wale spacing, but would be of little practical value to the engineer in this form, as it is too complex for ready calculation. We can reduce this, however, to a very handy diagram, Fig. 2, (see page 710) in which all the variables are taken care of except k, w and c. For the diagram some constant value is assigned to these variables and the cases in which they may differ from the values assigned are provided by means of a table of constants, which will be taken up later.

In the right-hand side of the diagram let the abscissas be N and the ordinates the depth D to the wale N. The third variable s is taken care of by constructing, in the left-hand diagram, a different vertical scale for each value of s. These scales will vary in length directly as the span, and so can be most easily laid off by drawing radial lines from the point of intersection of the surface line with the zero span line. Now solve the equation for s equal to 10 ft. for all values of N and timber sizes $b \times d$ and plot the curves as shown. The depths to the different wales will be found on the proper span line opposite the points where the vertical N lines intersect the wale curves.

For example, let us assume a cofferdam 25 ft. deep and 12 x 12-in. wales. The factors determining the wale size will be considered later. We will also assume a span length of 12 ft. Reading down the 12-ft. span line in the left-hand diagram opposite the successive points where the vertical "No. of wales" lines on the right intersect the 12 x 12-in. wale line, we get the following depths, 0, 5½, 9½, 12½, 15, 17, 18¾, 20½, 21¾, 23½, 24½.

It will be noticed in the diagram that the wales are numbered starting with the one at the surface. This would not be true in plotting from the formula, but for

practical reasons the numbers have been shifted to include this one.

Many cases will arise in which different values of k, w and c will be chosen. In order to meet these conditions a table of constants must be developed whereby the data as taken from the diagram may be modified to produce the correct results. The constant in Eq. (3) is represented by the expression

$$0.314\sqrt{\frac{k}{wc}}$$

Which for the diagram in Fig. 2 is

$$0.314\sqrt{\frac{1500}{62.5 \times 1}}$$

Therefore to obtain any other value for D_N with other values for k, w, and c, the expression will be

$$\frac{D_N \text{ (from diagram)}}{0.314\sqrt{\frac{1500}{62.5 \times 1}}} \times 0.314\sqrt{\frac{k}{wc}}$$

From which we get as the value of the constant by which we multiply the depths as taken from the diagram

$$\sqrt{\frac{k \times 62.5}{wc \times 1500}} \qquad (4)$$

The accompanying table is worked out for both level and surcharged conditions, the unit weights and constants c are taken from Peele's "Mining Engineers' Handbook," p. 2233. If we assume $k = 1000$ lb. per square inch and dry sand with level surface for the digging material, then the depths as found in the example previously worked out will be modified by multiplying by 1.24, giving the following depths, 0, 6.84, 11.78, 15.5, 16.61, 21.1, 23.3, and the next comes at the bottom, or 25.2.

Design of Sheeting—So far only the wales and struts have been considered, but as the pressure is transmitted to them through the sheeting, the relation between sheeting span to wale spacing must be determined and plotted on the diagram in order to determine the limiting thickness for each layout of wales.

From Fig. 2 the following relation holds:

$$\frac{whcl^2}{8} = \frac{kb't^2}{12 \times 6} \text{ or } t^2 = \frac{0.75wchl^2}{k} \qquad (5)$$

Let $l^2 = (D_{(N+1)} - D_N)^2$ and substituting the value of h from Eq. (2) into Eq. (5) and using Eq. (3)

$$s = \sqrt[3]{\frac{0.0349d^3}{t^2} \times \sqrt{\frac{b^3k}{wc}} \times \sqrt{N}\left[\sqrt{(N+1)^3} - 2\sqrt{N^3} + \sqrt{(N-1)^3}\right]^2} \qquad (6)$$

Solving this equation for the different values of t, bd and N with the same values for k, w and c as used for the wales, the sheeting lines can be plotted on the diagram (Fig. 2). These are shown at the left crossing the span lines.

It is important, at this point, to call attention to the fact that the sheeting thickness is determined by the span near the surface and *not at the bottom* as held by many. The reason for this becomes apparent from Fig. 2, whence it will be seen that, whereas the load on each wale and therefore each span of sheeting is constant, the span is greater at the surface—the bending moment being proportional to the span, in this case. Note that in Eq. (5) and (6) the sheeting spans l are not considered as continuous, this being in line with good practice, since it is difficult to tell very much about the strength of wooden sheeting after it has been driven the full depth of the cofferdam. In the case of steel sheeting, however, we can and do consider it continuous.

To make the diagram complete, lines have been added for Lackawanna steel sheeting, both for the ⅜ x 12¾-in. straight web and ⅜ x 14-in. arch web for 12 x 12-in. and 14 x 14-in. wales, the resisting moments of which have been taken from the manufacturer's catalog. It is interesting to note, by way of comparison, that, considering the wooden sheeting noncontinuous and the steel continuous, the straight web sheeting is approximately equivalent to 5-in. wooden sheeting and the arch web to something over 7 inches.

In determining the limiting sheeting thickness, in any case it must be borne in mind that this will be found in the diagram opposite the position of the wale, the minimum sheeting for the full depth being found opposite the second wale for reasons just stated; thus, the sheeting lines have been discontinued above this point.

In regard to the change in values of k, w and c as in the case of the wales, these functions bear the inverse relation to t that they bear to D, therefore the same constants will hold good, but, instead of multiplying, the thickness must be divided by them.

Economics of the Structure—In determining the value of the unit stress k, it is well to bear in mind that higher values than are used in permanent structures are permissible, since the matter of deflection is ordinarily of little moment, provided sufficient strength is developed, with a reasonable factor of safety. Thus, it is thought that, for ordinary uses, 1500 lb. is a good value.

The values of w and c are not so easily determined, being largely matters of mature judgment. In any event, it is important to look into the matter of possible saturation of the soil to the point where hydrostatic pressure will be developed and superimposed upon the earth pressure.

When we begin to look into the matter of the size and span of wales and braces, we see that quite a number of factors enter in, chief among which are (1) proper clearance for dredging and other work, (2) layout of the permanent structure within, (3) economic considerations.

Let us investigate, first of all, just when the most economical condition obtains and in connection therewith consider the other factors.

Nothing has been said, up to this point, about the size of braces, so it will be assumed that they are the same size as the wales, which is not theoretically correct, but the assumption suffices for this investigation, as will be seen further on.

From Fig. 1, the total ft. B.M. of timber =

$$\left[\frac{2LB}{s} + B + L\right]N\frac{bd}{12} + [L + B]2Ht$$

Substituting the value of N from Eq. 1

$$Ft.\,B.M. = \left[\left(\frac{2LB}{s} + B + L\right)\frac{0.375cwH^2s^2}{kd}\right] + [B + L]2Ht \qquad (7)$$

The expression in the first bracket represents the timber in the wales and braces and the second bracket the sheeting.

Our object now is to determine the conditions for minimum timber in Eq. 7. As will be seen, there are three variables s, d and t, and the last may be expressed in terms of the other two together with the breadth b.

The proper method of approach, from a mathematical point of view, would be to assume some values for b and d, differentiate BM. with regard to the span s, equate the result to zero and solve for s. The values so found will give us the most economical span for that particular value of b and d. Then assume s constant and do likewise for b and d. This procedure, however, leads into rather complex expressions, and so we will resort to graphical solution.

From Eq. 7 draw the curve for each size wale, assuming successive values for the span s. The values for the sheeting thickness will have to be taken from the diagram corresponding to the specific condition of span, etc. Such curves have been plotted in Fig. 3 for two different cofferdams of widely varying proportions of breadth B to length L, the first or upper set being almost square in plan, while the lower represents an elongated layout.

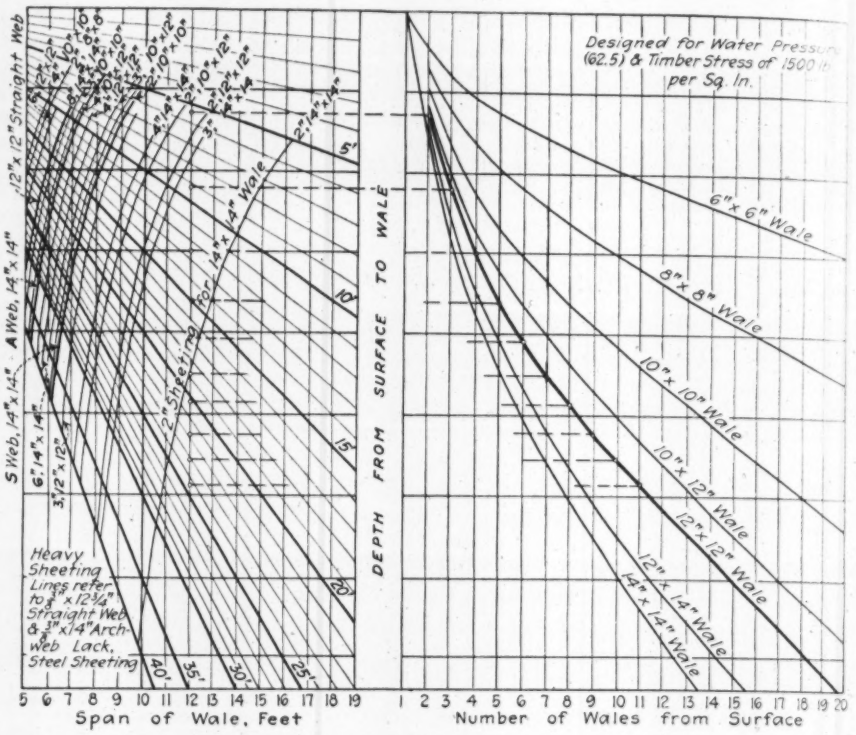

Designed for Water Pressure (62.5) & Timber Stress of 1500 lb. per Sq. In.
DEPTH FROM SURFACE TO WALE
6"x 6" Wale
8"x 8" Wale
10"x 10" Wale
10"x 12" Wale
12"x 12" Wale
12"x 14" Wale
14"x 14" Wale
Heavy Sheeting Lines refer to 8"x12¼" Straight Web & 7"x14" Arch Web Lack Steel Sheeting
Span of Wale, Feet
Number of Wales from Surface

FIG. 2. DIAGRAM SHOWING WALE SPACING FOR COFFERDAM

The point of minimum timber is clearly shown for each case and forces the following conclusions: The quantity of timber varies, in general, with the size of wale and inversely as the span, the most economical span for each wale being roughly proportional to its size. The point of minimum timber varies very little for the two different sets of curves, comparing like wales. The necessity for maintaining the proper distance between braces for the dredging bucket and the handling of material fixes more or less exactly the span of the wale. This, in practice, is in the neighborhood of 10 ft., and for the most economical layout would call for a 12 x 12-in. wale.

It is sometimes expedient to arrange the bracing regardless of the above in order to meet certain construction conditions, the saving resulting from this offsetting the increased cost of timber. These conditions cannot be anticipated here other than to call attention to their possibility.

Where steel sheeting is used, we have rather different conditions. From the first part of Eq. (7), which expresses the quantity of timber in the wales and braces only, we see that the most economical condition obtains when the wale size is a maximum and the span a minimum. Thus, the proper solution would be to fix the minimum span permissible, taking into consideration the points heretofore brought out, and then select from the diagram the maximum wale size limited by the

MULTIPLY DEPTHS TO WALES AS FOUND IN DIAGRAM BY FOLLOWING CONSTANTS FOR THE CONDITIONS SHOWN

Material	Unit Wt.	Level Surface C	Level Surface Fiber Stress 1,000	1,500	2,000	Surcharged = 6 C	Surcharged = 6 Fiber Stress 1,000	1,500	2,000
Water	62.5	1.00	0.816	1.00	1.155	1.00	0.816	1.00	1.155
Clay, wet	130	0.59	0.736	0.902	1.04	0.97	0.574	0.704	0.81
Clay, damp	120	0.16	1.47	1.80	2.08	0.70	0.70	0.86	0.99
Clay, dry	110	0.41	0.955	1.175	1.36	0.91	0.643	0.79	0.91
Sand, wet	120	0.33	1.02	1.25	1.44	0.86	0.635	0.78	0.90
Sand, damp	110	0.21	1.34	1.645	1.90	0.76	0.705	0.865	1.00
Sand, dry	100	0.27	1.24	1.52	1.76	0.81	0.72	0.88	1.02
Loam, wet	110	0.33	1.07	1.31	1.51	0.86	0.66	0.81	0.935
Loam, damp	90	0.16	1.70	2.08	2.40	0.70	0.81	0.995	1.15
Loam, dry	80	0.21	1.57	1.92	2.22	0.76	0.823	1.01	1.165
Gravel, graded	120	0.21	1.28	1.575	1.82	0.76	0.675	0.828	0.956
Gravel, coarse	110	0.33	1.07	1.31	1.51	0.86	0.66	0.81	0.935
Alluvium	90	0.50	0.961	1.178	1.36	0.94	0.696	0.856	0.985
Coal, anthracite	52	0.40	1.41	1.73	1.35	0.90	0.945	1.16	1.34
Coal, bituminous	50	0.27	1.75	2.15	2.48	0.81	1.01	1.24	1.43
Wheat	50	0.37	1.50	1.84	2.12	0.88	0.97	1.19	1.375
Oats	28	0.37	2.01	2.46	2.84	0.88	1.30	1.59	1.84
Corn	44	0.37	1.60	1.96	2.26	0.88	1.04	1.27	1.47
Ashes	40	0.21	2.23	2.73	3.16	0.76	1.17	1.43	1.65

The constant C as used above is taken from Peele's "Mining Engineers' Handbook."

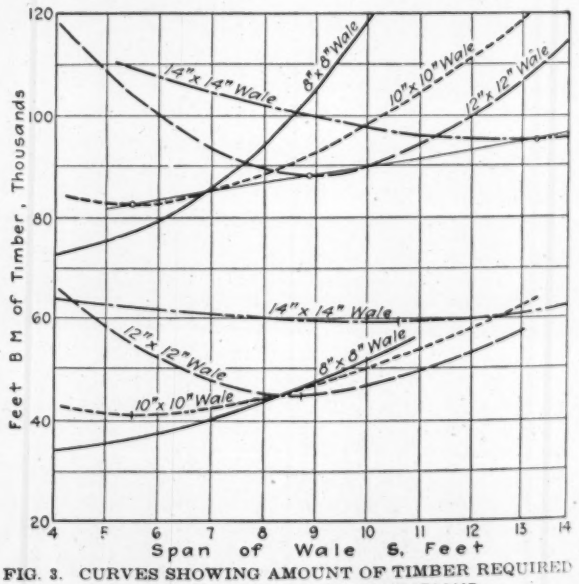


FIG. 3. CURVES SHOWING AMOUNT OF TIMBER REQUIRED FOR VARIABLE WALE CONDITIONS

sheeting. It is well to call attention to the fact that the sheeting thickness or strength will be fixed by the span between the first and second wales from the surface—not counting the one at the surface—and not the span from the surface to the first set. The reason for this is that the load upon the sheeting in the top span, as shown in Fig. 1, is just one-half that in the others; thus, the limiting size will be found in the diagram opposite the second wale, as stated before.

The size of the bracing is determined by practical considerations rather than theoretical. If we take the case of a 12 x 12-in. wale on a 10-ft. span, for the conditions in the diagram, we find that the allowable load on the wale will be 28,800 lb., which would call for about 40 sq.in. in the brace. This gives an absurdly small stick, and so, from the fact that the braces are subjected to heavy blows from one source or another, as well as from the necessity of providing sufficient area for end bearing of the wales and to satisfy numerous other construction requirements, it has been the custom to make the braces the same size as the wales or slightly smaller. This, however, does not affect the validity of our conclusions concerning economic conditions.

In conclusion, it should be pointed out that the foregoing results are based upon timber quantities and not upon the cost of the timber, the reason for this being obvious. We are here concerned with basic relations rather than local ones, which, when applied to concrete cases in connection with local conditions, will produce the most economical results for the general solution.

Blanket Lake Bottom To Stop Leaks From Water Reservoir

Dyke Also Built To Cut Off Bay From Which Loss Was Heaviest—Gage Observations Show Plan Successful

LEAKAGE from Bull Run Lake, which is a natural reservoir utilized for the water-supply of Portland, Ore., has been checked by blanketing the bottom and building a dyke to cut off a bay where much of the leakage was concentrated. There is no natural surface outlet or overflow, but the water passed out through an underground channel and emerged in the form of springs. A dam was built above this outlet to raise the water level. Leakage was discovered, however. through the boulders and shattered basaltic rock which appear to form the greater part of the lake bottom and the interstices of which have become filled with silt.

Clay containing some fine gravel is used for the blanketing, this material being obtained principally on the east side of the lake, about ½ mile from the work. It is transported on an improvised raft made of cedar logs, and equipped with a gasoline engine and propeller and a wooden 5-yd. hopper. The material is dumped from the raft in amounts depending upon the nature of the leaks. Where these occur among large boulders the blanket may have to be several feet in thickness, but where the bottom is of shattered rock a thickness of about a foot is usually sufficient.

The dyke is an earth fill, backed with large boulders on the outer slope. Material is deposited by means of skips run on wire cables and by the raft mentioned above, but after the fill nears the water surface it is finished by means of the skips alone. Care is exercised to deposit selected clay on the face of the embankment.

When the fill has been brought to the proper grade its inner face is riprapped to high-water level to prevent wash by wave action. Blanketing is carried out into the lake some distance beyond the toe of the dyke. No serious troubles have been encountered, the worst difficulty being found in obtaining suitable material for the dyke and for blanketing, as the formation is mostly loose rock and boulders, and a large quantity of waste material must be handled. All machinery and supplies for the work have to be hauled 20 miles in wagons from the nearest railway and then packed on horses for 11 miles over a mountain trail to the lake. The equipment, therefore, is necessarily light, and the work is more expensive than if it were accessible by wagon road.

To check the results of the work, observations were made by means of gages placed in the lake at various points, by the receding of the water in the bay outside the dyke, and by means of weirs at the points where Bull Run River emerges from the ground. As soon as the dyke was carried across this bay, where most of the leaks occurred, there was a noticeable decrease in the subsidence of the water in the lake as shown by the gages. There was also a marked decrease in the flow of the water over the weirs at points one mile and one and one-half miles from the lake. F. M. Randlett, engineer of the Bureau of Water-Works, who supplied the information here given, states that the larger part of the leakage is under control, although there are a few small and widely separated leaks that are to be located and stopped.

Control of Fires in Cinder Fills

Isolation appears to be the most satisfactory treatment of fires in cinder fills and culm banks. Such fires are a source of trouble on many railways using this material in fills for track and for building sites. According to report, the application of water usually has the effect of spreading the fire and even increasing its intensity, rather than extinguishing it. A method employed with success in many cases is to dig trenches to isolate the fire, which is then left to burn itself out. These trenches may be filled with clay or sand, while sand may be used also to bring the surface of the fill to grade as settlement occurs. One railway has had to dig out fires in cinder fills along its roadbed, using earth to replace the burning material. Trestles were burned on another road as the result of the practice of dumping cinders on the ends of the approach fills. Dumping at such places is now prohibited. On some roads, also, it is considered undesirable to use cinders as fills where buildings are to be erected, owing to the likelihood of trouble occurring from fires in the material.

Professional Organization in England

Abstract of an Analysis by Sidney and Beatrice Webb of the Motives, Methods and Results of Such Organization, Including That of Engineers

Many of the problems which are under active discussion among engineers in this country are keenly analyzed and discussed in the report from which the following abstract has been made. In many of its aspects the discussion covers with startling exactness the very conditions we find in this country, though the actual studies were on English professional organization. Among the topics touched upon are such pressing questions as division among professional societies, the strong centralized society versus the federation of societies, the cleavage between the leaders of the profession and the rank and file, professional responsibility to the community, the good points and the weaknesses of professional codes of ethics, and registration (or, as we call it here, licensing).

The report was made by Sidney and Beatrice Webb, the well-known English Socialist economists, for the Fabian Society, a Socialistic body, as a contribution to that organization's study of the control of industry. It appeared originally as a supplement to the "New Statesman," Apr. 21 and 28, 1917.

The full report takes up in separate chapters the professional organizations of lawyers, medical men, teachers, technicians (including engineers, architects, surveyors and chemists), of those engaged in literature and the fine arts, of those engaged in banking and various office activities, and of managers and superintendents. With this part of the report the following abstract does not deal. It does take up, however, the salient features of the two final chapters, which discuss the success, shortcomings and limitations of professional organization, and also the authors' conclusions.

The abstract is one largely made by Robert A. Cummings, consulting engineer of Pittsburgh, elaborated by additions from the original text.

Where italics are used in the abstract they are those of the editor of this journal.—EDITOR.

MOTIVES FOR ORGANIZATION

Three separate motives may be traced for the establishment of professional associations.

The first of these, and one which is usually placed in the forefront among the ostensible objects of the association, is the creative impulse—the intention and the wish to advance the knowledge and perfect the art of the vocation. This motive has not only resulted in the development of vigorous scientific societies but in genuine scientific work and intellectual comradeship. Moreover, the creative impulse is responsible for the professional code in one of its aspects, when it seeks to mark off the professional man from the profit-maker by a higher sense of honor, not only in his relations to fellow professionals, but also in those in which he stands to the community.

The second motive for professional association is that of fellowship among one's own kind, whether merely comradeship and social intercourse, or a willingness to befriend one's fellows; passing insensibly into an appreciation of the advantages of mutual assistance, and from that to mutual protection. The movement toward professional self-government is largely a development of this fellowship influence, which creates a desire to be judged or controlled by fellow members; that is, by persons who realize the conditions under which they work, and share their grievances and aspirations, rather than by persons with different social antecedents and outlook.

The third motive is the possessive impulse, the desire to secure for the members of the group all the remuneration and status which the community can be induced to accord for the performance of a particular service. The possessive impulse makes professional organization hostile to unqualified persons and even to those having a different technique. Obvious shortcomings of successful organization are the danger of an attempt to exact a higher remuneration or easier conditions of employment than are required to maintain the service in efficiency, and the objection to public regulation and to disciplinary inspection. The possessive impulse, however, is not always harmful. Without some protective development there is always a danger of any group being so crushed down as to be incapable of rendering its full service to the community. Without adequate security of a sufficient livelihood and a large measure of personal freedom in the execution of their tasks, neither the exercise of the creative impulse nor the maintenance of professional honor becomes possible.

The exercise of these three motives leads to a mutual development of each.

The professional mind is apt to be biased against new kinds of knowledge, against research which seems to lead into the domain of other vocations, and against innovations in technique which involve a change of outlook or a training different from that possessed by the existing practitioners. It is for this reason that we see arising "subject associations," confining themselves exclusively to the manifestations of the creative impulse; that is to say, the disinterested development of the science and art of the vocation; and protected against too much "professional egoism" by their inclusion not only of amateurs of the subject and men of other professions, but also of expert representatives of the "community of consumers." An instance of this is the Engineering Standards Committee.

CONDITIONS FAVORING GROWTH

It appears that the greatest reaction against vocational or professional organization was at the period when the functions of government were most limited. When state activity in a given line of service increases, we find corresponding professional organizations growing in membership and power. In fact, as the national and local governments have grown in scope and complexity of operations, they have been steadily making more and more use of, and therefore extending the influence and the power of, the professional organizations of brain workers, as a corrective to that development of bureaucracy which the collective control and conduct of public affairs inevitably necessitates.

Another set of circumstances has favored vocational organization. As long as industry is carried on by small

working masters, combining the functions of capitalist, undertaker, and business manager, and themselves using such scientific technique as was available, there was no professional organization. It was the growth of these business enterprises in size and complexity, and the consequent coming into existence of specialized classes of brain workers, divorced from participation in the profits, that led to the formation of the several professional associations. The rise of these associations in numerical strength and social power has been concurrent with the continual increase in the magnitude of the industrial enterprises with which their professional activities are concerned, and with the progressive elimination of the little working master.

Contributory to these two main causes of development is the continual elaboration and differentiation of professional technique. Without a sufficiently defined demarkation between the professional and the ordinary cultivated layman, no organization of a profession is possible. What happens is, first, the development of technique from its earliest germs and then the encouragement of the growth of technique by a professional organization.

Professional Ethics

Professional self-government has developed specialized rules of conduct. These rules can be classified under two heads, those relating to the conduct between professionals and those between professionals and the community.

The first set of rules forbids competition and criticism and prevents self-praise and advertisement. These rules discourage members of a profession from adopting unorthodox views and from associating with unqualified persons. They tend to good feeling and maintain a high standard of honor between professionals, but they may militate against innovations which make for progress, and they sometimes protect inefficiency and professional negligence.

In the most highly organized professions, an effort is made also to standardize the conduct of members of the profession toward the public. The most universal of these requirements is the distinction set up between what is permitted to a professional and what to a business man. According to the accepted canons of political economy, business men are permitted and even encouraged to compete with each other in price and quality, and to use the arts of advertisement to promote the sale of their wares. Moreover, they are assumed to make their profit by exploiting the labor of mind or body of their subordinates. They are also allowed or assumed to enter into secret understandings with other business men, with regard to sharing the profits of common undertakings. Above all, it is taken for granted that a business man will keep for his own profit any new invention or discovery that he makes, or of which he obtains control; and that he will attempt, whether by secrecy, by trademark, or by patent, to prevent anyone else from making use of it for the service of the public. All this is prohibited by professional ethics to the members of the most highly organized brain-working professions. The professional man is forbidden to take contracts in which the labor of other people is exploited for his own profit. He is always assumed to gain his livelihood solely by the use of his own faculties. He is prohibited from having any pecuniary interest, direct or indirect, in the materials, plants, processes or institutions which he recommends to his clients. So long as he is professionally engaged, he is required to think only of the advantage of his client and not of his own interest. In the higher ranges of professional ethics, he is expected to risk, and even to sacrifice, his health and his life in the performance of his professional duty, an expectation which never exists in business.

The weakest side of the ethics as elaborated by professional associations is the irresponsibility manifested with regard to the needs of the community. What the professional associations have always sought to protect is the interest of the practitioner, and the interest of the well-to-do client on whom he depends. This is true of all the learned professions, including engineers, who have been too eager to patent their own inventions to encourage their professional associations to concern themselves about how to make these inventions serviceable to the community.

If professional organization demands greater powers of government over the work of its members, and claims to decide how each profession shall be organized and conducted, it must give more attention to the requirements of the community as a whole, not merely for those persons who can pay the fees desired but for the whole population.

On the whole, the development of professional ethics has been one of the finest results of professional organization. But it has its dangerous aspects. It may be used to prevent the upgrowth of a new technique or a new method of organizing the profession in the public interest.

Militant Methods

All the devices by which trade unions attain their ends have been practiced by professional associations. For instance, there are restrictive devices requiring prolonged apprenticeship, limitation of the number of apprentices, the exclusion of women, the refusal to operate professionally with unlawful or recalcitrant practitioners, and the rejection of novel methods of performing the service which the public might desire.

So long as practitioners worked entirely for a succession of individual clients, the method of collective bargaining and the refusal to accept service under unfair employers were not open. As soon as professionals began to be employed at salaries, they took to collective bargaining and insisted upon a standard minimum of remuneration, refusing to accept employment, resorting to the boycott and even the strike. This is particularly true of the teachers and doctors, and in one or two cases their associations have been registered as trades unions. Professional associations have practiced militant action by resorting to political pressure, and this has become an important feature of the modern association.

Registration of Qualified Persons

In all brain-working vocations which have developed professional organizations there has arisen among the bulk of the practitioners a demand for statutory or otherwise authoritative registration of legally qualified practitioners. This demand has always been accompanied by insistence that the determination of this qualification, and, therefore, the keeping of the register, should be entrusted to an existing body of practitioners who consider themselves qualified. This identification of a register by legally qualified persons with professional self-government is, it is needless to say, neither logically nor practically necessary, and has, in

fact, often not accompanied statutory registration. In England today, where vocational organization is, on the whole, stronger than in any other country, the authoritative registration of legally qualified persons is nowhere accompanied by complete democratic vocational self-government. In many cases appointments to the governig body are made by "oligarchical corporations," such as the Colleges of Physicians and Surgeons.

The keeping of the register has resulted in prolonged controversy, the most remarkable feature of which has been not the divergence of interest between the vocation as a whole and the community as a whole, but the embittered quarrels over policy between the aristocracy and the rank and file of each profession. The agitations which have recently arisen for the statutory registration of architects and accountants, and, in a lesser degree, of engineers, are hampered by the internal dissensions within each of these vocations. The leading members of each profession see no advantage in a statutory register of qualified practitioners. What they prefer to seek are clauses in statutes and administrative orders compelling particular authorities to employ only the members of the dominant professional association. Moreover, even when the leaders of a profession give a perfunctory support to any movement for registration, they always insist that the authority controlling the register shall be predominantly made up, not of representatives of the rank and file of the profession, but of its superior grades.

The great institutions of engineers have latterly come to exercise great influence in favor of a monopoly for their own members in the appointment to important engineering posts, while during the war the recognition by the Government of these great institutions in the selection of men for commissions in the Army and places in munitions works is virtually handing over to members associates and students of these institutions the monopoly of certain grades of engineering. These indirect ways of establishing a register of persons qualified to hold remunerative posts of a public character may, in fact, be a more effective, because a more secret, way of securing for a certain group of persons a monopoly of employment. Even the growth of public opinion in favor of professional representation on royal commissions and departmental committees inevitably leads to the recognition of the membership of the principal professional association concerned as the only source from which representatives of the profession can be drawn.

Unit of Organization

In so far as professional association is based on the voluntary principle, the unit of organization seems strictly limited by the condition that all the persons to be included must have essentially identical interests on the main questions of policy. This is the fundamental cause of the variegated character of the voluntary associations of brain workers, which are always tending, with the increase in the size and diversity of the profession, to break up into new units corresponding to new group interests. It is to this cause that we ascribe the characteristic impermanence of voluntary organization among brain workers—the constant supersession of one association by another, and the perpetual shifting in relative importance of the different associations in the profession.

Nor is this tendency to a breaking up into separate societies, each pursuing its own policy, confined to differentiation of technique. We see it manifesting itself when some members of a profession, among whom are represented various types of technique, find themselves marked off from the bulk of their profession by some peculiarity of employment. The engineers working for local authorities, whether on drainage, electricity, bridges, road making, or the construction of buildings—not satisfied with the various specialized institutions of their profession—have united in a powerful organization of County and Municipal Engineers.

What determines the basis of these perpetual regroupings seems, therefore, to be not only the development of a common technique, but also the opportunity for social intercourse, the sense of a common interest, and especially the existence of common enemies, whether these are other sections of the same profession or a particular type of employer. Where a general organization includes within its scope divergent sections of one vocation, having mutually conflicting interests, differences of technique or different methods of remuneration and conditions of service, it tends either to become inert, or else to develop within itself separate associations or groups which act as caucuses pushing the divergent interests. These caucuses may end by making the association more of a battlefield than a platform for common action. Hence, one of the problems of professional organization is whether the greatest measure of common action can be obtained, where such diversity of interests exists, by *an amalgamated association* with common funds, a common policy, and a common government, or by *a loose federation of separate associations, delegating to the federal body only such powers as can be exercised with the consent of all the sections concerned.* Thus, for one or other reason, with every increase of professional organization in influence and membership, there seems to be—if the organization is on a voluntary basis—an increase in the number of separate associations, and an intensification of the diversity of their several policies.

What Is a Vocation?

When any demand is made for statutory powers of self-government, what are to be the outer limits of the vocation? Does the profession consist of all those who "habitually and for gain" coöperate in the rendering of the service or the provision of the commodity? Must we include all the indispensable contributors to the service, such as craftsmen, skilled and unskilled?

It is needless to say that no voluntary association coinciding with a vocation in this wide sense has ever arisen, or shows any sign of arising. Professional association if left to itself is always limited by the requirement for its membership of a common technique, practical opportunities for social intercourse, and a certain identity of pecuniary interest as against other classes. But when it is proposed to delegate to a profession any powers of government, the limits of the vocation to be subjected to these powers have necessarily to be defined.

Where statutory authority has been conferred, it has always been of wider scope than the membership of any one association. What has been conferred on professional association has been only the power to regulate the qualifications and conduct of certain grades of practitioners. The reason for this limitation of a unit is that the needs of a vocation can be properly understood and appreciated only by those habitually dealing with

its technique. Each service includes many techniques and a good deal of unspecialized work. *It is thus identity of training and technique, not coöperation in the service, which furnishes the boundaries of any statutory organization.*

Government of Professional Organization

Growth of self-goverment within a profession always brings about a more or less embittered dispute between the advocates of government by a select class and those of government by the rank and file. This dispute is largely responsible for the multiplication of voluntary organizations.

Is the aristocrat of the profession—the person who has enjoyed a longer and more extensive training than the ordinary practitioner, or who has developed a specialism involving a difference in technique, or who has acquired the hallmark of superior academic distinction—to be endowed with greater rights than the members of the profession having only the statutory minimum qualification? It is interesting to note that the limitation of government to a superior grade of the profession in choosing the governing council or in declaring the policy of the organization has been adopted by many of the principal voluntary organizations. Where an oligarchical constitution of this kind has not been adopted, there is a tendency for the superior grades of the profession either to abstain from joining, or at any rate from taking any active part in its affairs; or, on the other hand, for separate organizations of the superior grades to spring up either independently or within the main association, forming a powerful caucus for the promotion of sectional interest. When united action of the profession as a whole becomes indispensable, we see these various associations coming together in more or less permanent federation; and in such cases the rule is for the several associations to meet on equal terms, with equal representation, irrespective alike of gradations of rank or numerical membership—thus preserving the rights of the numerically smaller upper grades.

Whenever it is found necessary to bring in any statutory authority all these questions become acute. The main body of practitioners always desires to have the council elected by the profession as a whole, voting in equal geographical districts; but this procedure would involve the swamping, by the great numerical superiority of the rank and file, not only of the leaders of the profession, and, indeed, of the whole of the higher grades, but, what is no less important also of the various small minorities of specialists or practitioners of particular technique. There is thus a tug-of-war between the more select classes and the rank and file of the profession, the first using their political influence with the statesmen and the heads of the bureaucracy, by whom their professional superiority is appreciated, and the second appealing through the popular electorate to the members of Parliament. In the extremely important Engineering Standards Committee, which did not "come into the limelight," the influence of the superior grades has been paramount.

The question whether the professional organization shall be governed by the rank and file, or by the members of its superior grades is more important to the public than may at first sight appear. If the influence of the rank and file is decisive, the tendency is towards (1) maintaining only one ungraded qualification, so that there shall be no claims to superiority of status; (2) upholding a policy of "sharing out" the work, which leads to the objection to salaried service; (3) a preference for "rotation of office" or promotion by seniority; (4) keeping the qualification for public appointments low, so that they may be within the reach of all; (5) objecting to any requirement of a particular training, experience or academic attainment. On the other hand, in associations in which the influence of the superior grades is dominant we find (1) a desire for a graded profession, in which each grade has its own qualifications for entry; (2) a bias in favor of reducing the intellectual qualifications required for the lowest grade, in order to widen the gulf separating it from the higher grades; (3) a policy of restricting public appointments and honors of the profession exclusively to the members of the highest grade, irrespective of the special talents or special experience of exceptional members of the lower grades. It must not be taken for granted that either of these policies is necessarily good or bad. What is bad is that they are constantly being pressed heedless of the interest of the community which the profession has to serve.

Results of Professional Organization

The results of professional organization have been of a very mixed kind.

Effective organization, in the way of beneficial effects, raises the standard of professional honor, improves the education of its members, increases the opportunity for their professional training, disseminates improvements in professional technique, and promotes the scientific study of its subject matter. In all these ways professional organization has for its result an improvement of the service which the profession has to render the community; and it is not a matter for complaint if, coincidentally, there is also a raising of the status of the profession in public consideration, and even an increase in its aggregate emoluments and privileges.

There are, however, other results which are more invidious. Professional organization seems never to escape a tendency to exclusiveness. Whenever it controls or influences the entry into the profession, it tends through educational qualifications, apprenticeship and high fees, to confine the recruiting of the profession to the small social class which alone can afford for its children a long and expensive schooling of the conventional type. These onerous and restrictive conditions of entry are often justified by the importance of securing in the profession persons of cultivation and superior attainments.

No less serious is the influence of professional organization in refusing to recognize any but the science and art that were current in the generation that is passing away. This reluctance to admit the new knowledge or the new processes is seen at its worst when what is knocking at the door is some revolution which would shift the boundaries of the profession, transfer some of its service to another set of practitioners, or consign to the scrap heap some of the processes by which its members have gained a living.

Sphere of Professional Organization

Professional organization has shown itself to be of the greatest use to the community where it has been inspired by the creative impulse, with which the fellowship impulse is often associated. It is, in the main, to

the individual and collective activities of the existing body of practitioners—these activities being heightened by professional association—that the community owes most of the continuous advance in the science and art of a profession; because these practitioners alone enjoy that combination of knowledge, training, and daily opportunities for discovery upon which progress normally, although by no means invariably, depends.

Professional organization is, moreover, indispensable as a defensive force. Experience demonstrates that it is required for protection, alike of the individual practitioner against the economic oppression and lay tyranny to which he may otherwise be subjected, and of the profession itself against conditions and restrictions which would withhold from it the necessary means of training and improvement, deny to its rank-and-file members an appropriate standard of life, and prevent the most efficient service.

But professional organization has also an important part to play in the government both of the profession itself and of the service which it renders, and, therefore, in the government of the community. The very specialization of the professions renders it both difficult, and in the public interest undesirable, for the government of the professions to be carried on exclusively and autocratically by a lay authority, even if it represents the consumers, or by a bureaucracy trained only to administration.

On the other hand, it is undesirable to give to professional organization undivided control over the conditions of entry to the profession, the training required, the power of expulsion from a statutory register, the organization of the service, the terms of public employment, the technique to be encouraged or prescribed, and the treatment to be meted out to "unqualified practitioners." What is required is some sort of composite authority, such as the Engineering Standards Committee, in which there can be represented, not only the knowledge and desires of the profession, but also the interests of the consumers or users of the particular service, the larger and more enduring interests of the state, and even the knowledge and desires of other professions which may be indirectly concerned. The first function of professional organization is to supply duly authorized representatives of the profession to such composite authority.

The second function of professional organization in connection with the government of its service, and the most important of all, is one which has so far scarcely been claimed by professional associations. This is the function of independent, authoritative criticism of the government of the state, alike in its central and in its local administration, and of responsible advice, both to the legislature and the executive on matters in which the profession has special competence. One of the gravest drawbacks of the bureaucratic administration which is involved in all enterprise on a large scale is the immunity from expert criticism which is now secured by official secretiveness and departmental discipline, and the practical monopoly of access to the mind of the minister or governing committee possessed by the departmental chiefs. We know of no effective organ of criticism except that which might be afforded by professional organization.

Perhaps the most important of all of the aspects of this criticism and advice which it is the duty of professional organization to supply to the state is one which has hitherto been entirely neglected. It should be a matter of professional honor for the collective organization of each profession to see to it, *not merely that its members are well qualified and properly remunerated, but also that the service of the profession is supplied in adequate quantity for the needs of the community, not only the rich but also the poor.*

The Unsolved Problem

The most intractable problem of professional organization, and one for which this report offers no complete solution, is how to discover, in each profession and in each branch of a profession, the most effective unit of organization, and the most appropriate method of formulating a general will, alike as an organ of expression and criticism, and as an instrument for supplying representatives to composite authorities. The simple solution of asking all the registered or recognized practitioners to elect a council representing the entire profession has two capital drawbacks. It submerges all the expert specialists, and all the newer and smaller sections, in the undistinguished mass of the rank and file pursuing the old routine. Moreover, even when provision is made for enabling these minorities to have a share in any pronouncements of the council, the result is blurred and ineffective; in the compromise between the different elements the specialization of knowledge and intensity of emotional experience, or just what is most valuable in vocational association, is inevitably lost.

Finally, the characteristic impermanence of professional associations, which results naturally from the constant shiftings of a progressive technique and a changing social environment, makes it difficult, without an objectionable stereotyping of that which is in its nature variable, to base upon these voluntary associations any formally constituted professional council which is intended to be permanent. *The only inference we can draw is that the constitution of any professional council, whether statutory or voluntary, must necessarily be complicated, ought always to be elastic, and will need to be perpetually revised.* A solution may perhaps be found in an elaboration of what may be called "stratified democracy," in which the affairs of each grade or special section are dealt with separately by that grade or section, with an independent and uncensored right of expression, as well as by the profession as a whole.

Status of Government Motor-Vehicle Equipment

Delivered and uncancelled contracts for motor vehicles of all types for the Government Army service covered 254,626 units, by recent report. Of these 223,871 have been delivered and 30,755 are still under contract. Motor trucks of all kinds total 115,137, of which 96,551 have been delivered and 18,586 are still under contract. Motor cars, ambulances, motorcycles, trailers and bicycles to the number of 139,489 have been contracted for; 127,320 have been delivered and 12,169 are still to be delivered. These figures do not include 4847 Ordnance Department trailers which were purchased. Of the total number of motor vehicles, 126,111 are overseas, while 97,760, which number includes those still under contract, are in the United States. It is reported that large numbers of these trucks will be transferred to the Postoffice Department for the transportation of mail and parcel-post matter.

Long-Distance Motor-Truck Haulage Costs in Ohio

Routes Between Akron, Youngstown and Cleveland Investigated—Present Rates Too Low—Operate for 52 Cents per Truck Mile

AN INVESTIGATION made of one of the long-distance motor-trucking companies, operating between Akron, Cleveland and Youngstown and covering a 12-months' period, has recently been completed by Melvin W. Boyle for the Packard Motor Car Co. The results of the investigation show that freight rates which have heretofore been charged are much too low—not giving a reasonable profit to the truck operator. The cost of running a 3½-ton truck averaged $28.89 per day when covering an average distance of 55 miles, or about 52c. per mile. The investigation was made to determine what rates should be charged, as indicated by the actual cost of doing business. The following is an abstract from the report covering the investigation:

Freight shipments between Cleveland and Akron were found to be much greater than those between Cleveland and Youngstown. The amount hauled between the former places was 80% of the total. However, the cost per mile on the haulage of the 20% transported between Cleveland and Youngstown showed the same cost per mile. The investigation covered a company operating twelve 3½-ton trucks. The amount of freight from Cleveland to Akron was just about double that from Akron to Cleveland; the average loads being 8500 and 4300 lb., respectively. Thus, the trucks generally ran one way only half loaded. If this could be remedied the indicated rate would be cut considerably.

One of the largest factors tending to increase the cost of operation was found to be the condition of the roads. Breaks in the surfacing requiring detours, failure to remove snow, etc., all caused costs to jump. At times it took trucks from two to three days to make a return trip between Cleveland and Akron. Trucks were blocked in the snow, requiring gangs of men to dig them out, and often an extra truck had to be sent to assist. After every heavy snowstorm the trucks had to break their own way, not only being delayed thereby but having excessive repair charges due to the wear and tear. The extra expenses for drivers, gangs of men, etc., mounted when bad conditions were encountered. During the spring months the road was impassable in many stretches, which required long detours over poor roads in which deep ruts and holes were formed, often causing breakage of springs, injury to differentials and other damage.

Mileage Figured

The average number of miles covered per truck per day was 55, or 16,500 miles per year of 300 days. This mileage allows for truck repairing, overhauling, time lost in loading and unloading, and various other delays. Thus, although the actual speed in operation was much greater, the average was cut down by this loss of time. The development of the pneumatic tire will undoubtedly increase mileage and thereby lower the cost; however, this tire has not yet been put on the market for the larger trucks, and cannot be an immediate remedy.

Referring to the accompanying table, some of the items need explanation. Item 5, driver's expense, covers meals and room rent when out of town. Item 10 covers the expense of a repair gang which is necessary in long-distance motor trucking. This gang must consist of men competent to repair trucks, and it must be ready to work night or day when trucks are broken down. The records show that two mechanics were necessary to keep 12 trucks moving. Item 11 covers one complete overhauling per truck per year, which has also been found necessary. Item 13 covers warehouse charges, salaries, office expense, traveling expenses, etc., for the three cities on the route.

OPERATING COST FOR LONG-DISTANCE TRUCKING, BASED ON 55 MILES PER DAY AND 300 DAYS PER YEAR

Item	Cost Per Year	Cost Per Day	Cost Per Mile
1. Interest on $5,000 at 6% on depreciated value	$180 00	$0 60	$0.0109
2. Insurance, complete protection	450 00	1 50	.0272
3. Depreciation at 20% per year	1,000 00	3 33	.06
4. Driver at $5 00 per day	1,500 00	5 00	.0909
5. Driver's expense	300 00	1 00	.018
6. Helper, part time	100 00	33	.006
7. Gasoline, 3.2 miles per gallon at 25c	1,288 65	4 29	.0781
8. Lubricants, 78 miles per gallon at 58c. and 10c. per day for grease, etc	155 10	51	.0094
9. Tires, 36 x 5, dual rears at $448.00, less 10%	952 05	3 17	.0577
10. Repair men, 1 at $1,900 per year 1 at 1,500 per year $3,400 ÷ 12 trucks	283 33	94	0171
11. Repairs—Overhaul	600 00	2 00	0363
12. Garage	225 00	75	0136
13. Overhead, $1,600 per year each truck	1,600 00	5 33	0969
Totals	$8,634 13	28 75	$0 5221
14. Claims ½%	43 17	14	0026
Complete total	$8,677 30	$28 89	$0 5247

Computation of Necessary Freight Rates

In a trip from Akron to Cleveland and return the distance covered averaged 100 miles. This was due to a certain mileage covered in each city, in delivery and pick-up. Using the cost per mile as shown in the table, the cost per trip would be $52.47. The average tonnage, as stated before, was one-half load up and a full load back, or an efficiency of 75%. On a basis of 8500 lb. for a full load, the costs and the indicated freight rates are as follows for various efficiencies:

For 75% efficiency, the combined load would be 12,750 lb., transported at a cost of $52.47, or $0.4115 per hundredweight. With a profit of 20%, the indicated freight rate would be $0.4938.

At 83% efficiency or two-thirds loaded one way and a full load the other way, the combined load would be 14,168 lb., or an average cost per hundredweight of $0.37, which with a profit of 20% added would give an indicated freight rate of $0.444.

With a 100% efficiency, or a combined load of 17,000 lb., the indicated freight rate per hundredweight would be $0.369. The records showed practically no difference in operation cost for loaded and empty trucks.

Present rates are far below these indicated rates, principally because the operators had to make a tentative rate until the limiting costs had been determined. Furthermore, the established trucking companies are put at a disadvantage by the man owning a single truck who is willing to use it for a day or two in good weather to keep his truck busy. To run a legitimate trucking business, the operator must work summer and winter and in all kinds of weather, and if manufacturers want this service they must pick a dependable concern and pay a profit; otherwise, the trucking companies will have to go out of business.

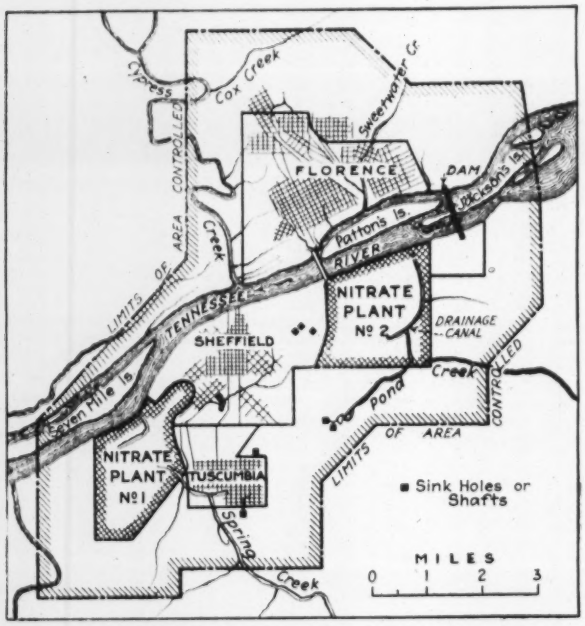
It may be interesting to know that of at least 20 companies, many small and a few of good size, which have operated between Akron and Cleveland, there are only two still in business which have operated over one year.

Malaria Control at Nitrate Plant

Mosquito Eradication by Clearing, Drainage and Oiling Water Surfaces Reduces Disease 95 Per Cent in Alabama District

By W. G. Stromquist
Sanitary Engineer, United States Public Health Service, Florence, Ala.

TO SAFEGUARD the health and increase the efficiency of the 20,000 employees building the two nitrate plants at Sheffield, Ala., the United States Public Health Service in March, 1918, by request of the Alabama State Board of Health, organized the Muscle Shoals sanitary district, including the nitrate plants,



MOSQUITO EXTERMINATION DISTRICT INCLUDES CITIES AND NITRATE PLANTS

the construction camp of the Tennessee River dam and the cities of Florence, Sheffield and Tuscumbia. Malaria being prevalent and the plants drawing a large proportion of labor from malarial sections, measures for control of this disease were an important feature of the activities. An area of approximately 60 square miles was included in districts where the mosquito-eradication work was done.

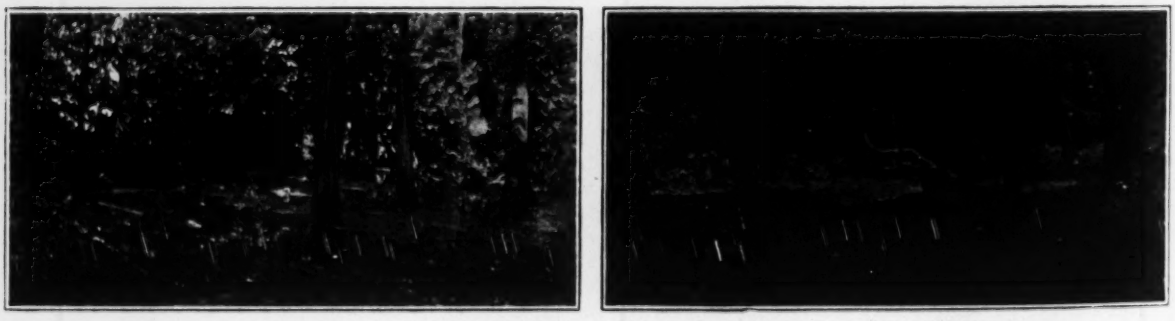
North of the Tennessee River the topography is hilly, with level bottom lands along the river. Except for sloughs in the bottoms, the drainage is good. The larger islands contain swampy areas. A high bluff cut by steep and narrow gullies borders the south bank, beyond which the land is level to rolling. A number of drainage areas have no surface outlet, so that there are many ponds. In general, the soil is loam and clay overlying limestone, which outcrops in many places. Sink holes in the limestone region provide outlets for the surface water of some of the isolated drainage areas.

As malaria-carrying mosquitoes may fly one mile from their breeding places, all water surfaces within that distance of the area to be protected were considered a menace. A hurried survey determined the five most important problems, which are shown by the map: The Pond Creek area; Spring Creek; sloughs on Patton's Island and in Florence; sloughs in the river bottoms west of Cypress Creek, and, finally, a large number of ponds.

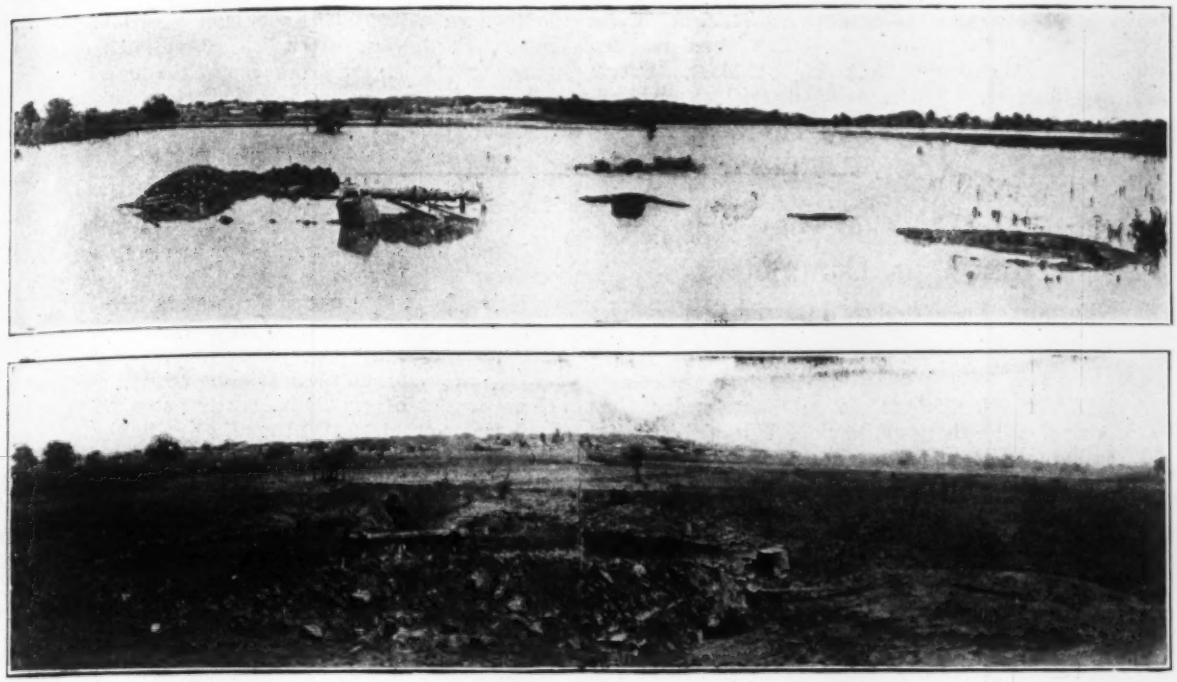
Drainage was the prominent feature of the work, in order to eliminate breeding places. Ditches were dug or improved, new channels cut and old channels cleared of brush and drift, all this being supplemented by oiling. Some of the heaviest work was on Patton's Island. Conditions there before and after drainage are shown in the accompanying views. A canal built to carry waste water from Plant 2 to the river provides drainage for a swampy area, and a lateral from this intercepts part of the flow of Pond Creek. Vertical drainage by natural sink holes and vertical shafts was a feature of the work. Two sink holes forming the only natural outlet of Pond Creek were enlarged, a timber crib 10 ft. square and 30 ft. deep being sunk in one of these. A 40-acre pond near the business section of Sheffield was drained by a shaft 40 ft. deep, with results shown in two of the views, printed on the next page.

Approximately 30 miles of streams were cleared, 12 miles of new ditches dug and 12 miles of old ditches improved. Ditches require frequent attention, to prevent obstruction by vegetation and drift. Very little maintenance was done last season, however, owing to the greater necessity of completing the drainage work, but as the season was unusually dry there were no ill effects.

Mosquito breeding was controlled in all water surfaces by oiling with a 1:2 mixture of black oil and kerosene. The oil was delivered in barrels and distributed so as to be readily accessible for the oilers, who carried 5-gal. knapsack sprayers. Each man cov-



CONDITIONS ON PATTON'S ISLAND BEFORE AND AFTER MOSQUITO WORK
This slough is within mosquito flight distance of Nitrate Plant 2 and Florence.



A POND OF MORE THAN 40 ACRES AT SHEFFIELD, ALABAMA, WAS DRAINED BY 41-FOOT VERTICAL SHAFT INDICATED BY WINDLASS

This pond covered "city lots" near business center of city. Conditions before and after drainage are shown by the two views.

ered a district of 5 to 6 square miles. Drip cans used on the smaller streams were 5-gal. galvanized cans with a ¼-in. air cock near the bottom. These were placed in boxes and suspended about 5 ft. above the water, being adjusted to drop 15 to 20 drops per minute. This treatment was supplemented by spraying.

Medical students were employed to inspect the oiling and to look for mosquito breeding, each inspector covering two or three oiling districts. Numbered signs at ponds and along streams and ditches facilitated the daily reports of oilers and inspectors. Oilers reported all ponds visited, and whether oiled or found dry. Inspectors reported as follows: Oiled, needs oil, or dry; mosquito larvæ present or not found. In general, oiling and inspection were done once a week. About 55 miles of streams and ditches and 300 ponds were oiled, using 14,500 gallons.

Labor shortage was one difficulty. With an eight-hour day as a basis the men worked 10 hours, receiving time and a half for overtime. At first laborers were paid 25c. per hour, which was soon increased to 30c. and then to 35c. near the end of the season. Foremen were paid $5.50 and $6.60 per day. High wages and a poor grade of labor greatly increased the cost. On the drainage work, from three to eight gangs were maintained throughout the season. These varied from six to 30 men, according to the nature of the work, but in general it was found best to have 12 to 15 men in each gang. The fact that some of the foremen were familiar with local conditions and took personal interest in the work was an important factor in its success.

Five medical students were employed as oiling inspectors from about June 1 to early in September. An engineering student made surveys and kept cost records. A maximum of nine laborers were used as oilers. The maximum force was 140 men. Federal funds bore the expense of supervision, labor, the purchase and upkeep of two trucks, gasoline and oil for the trucks and for cars used in supervision of the work. Funds appropriated by the two counties and the three cities were used to buy tools and other equipment.

Cost records were kept, with actual man-hours, the foremen making daily progress reports. The cost of drainage and maintenance work was divided into labor, foreman, transportation and incidentals. The cost of oiling included labor, inspection, transportation and oil. The transportation charges consisted of the truck drivers' wages. The total cost was approximately $60,000. With 50 square miles controlled, exclusive of the plant reservations, the cost per square mile was $1200, distributed approximately as shown in the accompanying table. With the most difficult and expensive work completed, and the probability of lower wages, it is thought that the mosquito breeding could be controlled during the coming season at about one-third the cost for the first season. It is expected that the local authorities will appropriate funds and that supervision will be maintained by the United States Public Health Service.

COST OF MOSQUITO ELIMINATION, PER SQUARE MILE

Supervision	$80
Labor:	
Drainage	800
Maintenance	25
Oiling (including inspection)	100
Transportation:	
Cost and upkeep of trucks and automobiles	85
Tools and supplies	60
Oil	50
Total	$1200

Malaria has been reduced 90 to 95%, according to local physicians, but there are no records of the number of cases in previous years. The absence of mosquitoes is a subject of favorable comment by residents.

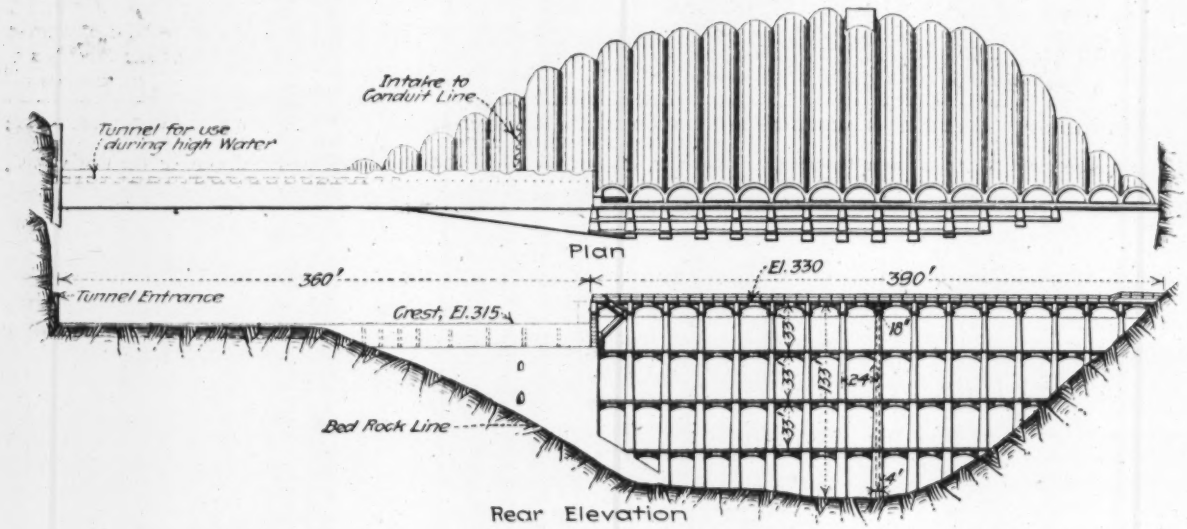
The mosquito-eradication work in this and other dis-

tricts has been under the supervision of J. A. A. Le Prince, senior sanitary engineer. R. E. Tarbett, sanitary engineer, organized the work in the Muscle Shoals sanitary district. The general activities were organized by Surgeon L. L. Lumsden, with Assistant Surgeon H. S. Mustard, and later Assistant Surgeon Thomas Parran, Jr., as medical officer in charge. The writer was in immediate charge of the mosquito-eradication work, assisted by H. R. Fullerton, assistant sanitary engineer.

Record Height Concrete Multiple-Arch Dam Completed

Dam Forming Lake Hodges in Irrigation District Near San Diego Is 136 Feet from Crest to Low Point in Valley

A MULTIPLE-ARCH reinforced-concrete dam just completed by the San Dieguito Mutual Water Co. in southern California has an overall height of 136 ft., which makes it the highest structure of this type on record. It is located on the San Dieguito River about 30 miles from San Diego, and will have a storage capacity of 38,000 acre-ft., which is to be used for irrigating lands in the valley below.



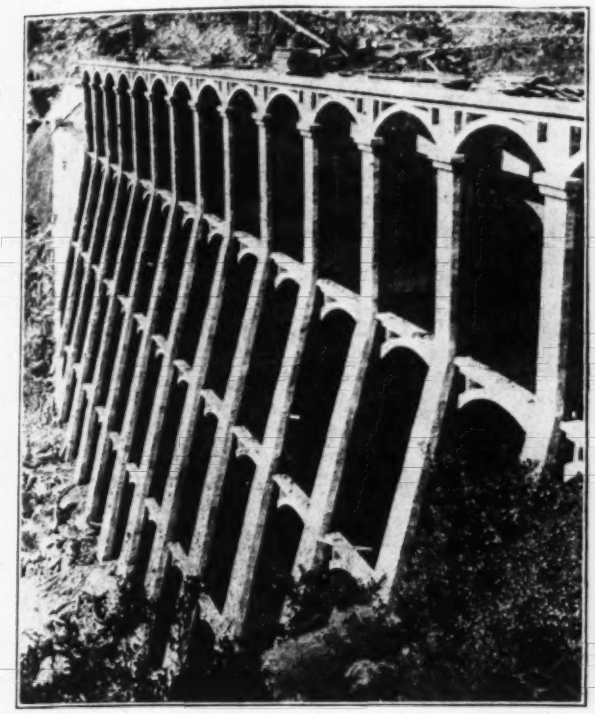
LAKE HODGES DAM FOR SAN DIEGUITO MUTUAL WATER COMPANY, CALIFORNIA

The length of the concrete structure across the gorge is 558 ft., the balance of 192 ft. being a wide bench at the north end of the dam excavated in the solid rock in order to provide a spillway of 70,000 sec.-ft. capacity. This capacity was required by the State Engineer's office, as the maximum stream flow on record at this point is 72,100 sec.-ft. The total length of the spillway provided is 360 ft., of which 192 ft. is excavated from the mountain side, and 168 ft. is in the form of a rollway over the top of the concrete structure at its north abutment. The storage capacity in the 15-ft. rise between the spillway level and the top of the dam would be 38,000 acre-feet; that is, equal to the net capacity below spillway level. In order to avoid obstructing the spillway with piers supporting an overhead bridge, access to the valves under the dam is maintained during high water by means of 4 x 6½-ft. concrete-lined tunnel built under the spillway for a distance of 192 ft., connecting at this point with a series of concrete foot bridges extending under the dam through the buttresses and from which the blowoff and service gates can be reached.

During low-water periods, operators have access by a more convenient entry, through the downstream face of the spillway, into the chamber where the valves admitting the water to the irrigation conduit are located. These consist of six 20-in. outlet gates set so as to draw water off at 10-ft. lifts. Each gate has its screen and connecting pipe to the conduit, which through the structure and beyond, is a heavily reinforced-concrete tube tied to the buttress at one side and laid on bedrock throughout. There are also four 24-in. blowoff valves at the lowest point of the dam. The latter are reached from a suspended concrete stairway running down from one of the concrete footwalks mentioned before.

The buttresses, which rest on bedrock, have no reinforcement except where arches, strut-beams and foot walks are tied in. They are spaced 24 ft. on centers and vary in thickness from 4 ft. at the bottom of the tallest buttress to 1½ ft. at a point 47 ft. below the top of the structure, and above this point this thickness is maintained. Each buttress has a showing face 2 ft. thick and increasing in width from 4 ft. at the top to 8 ft. at the bottom.

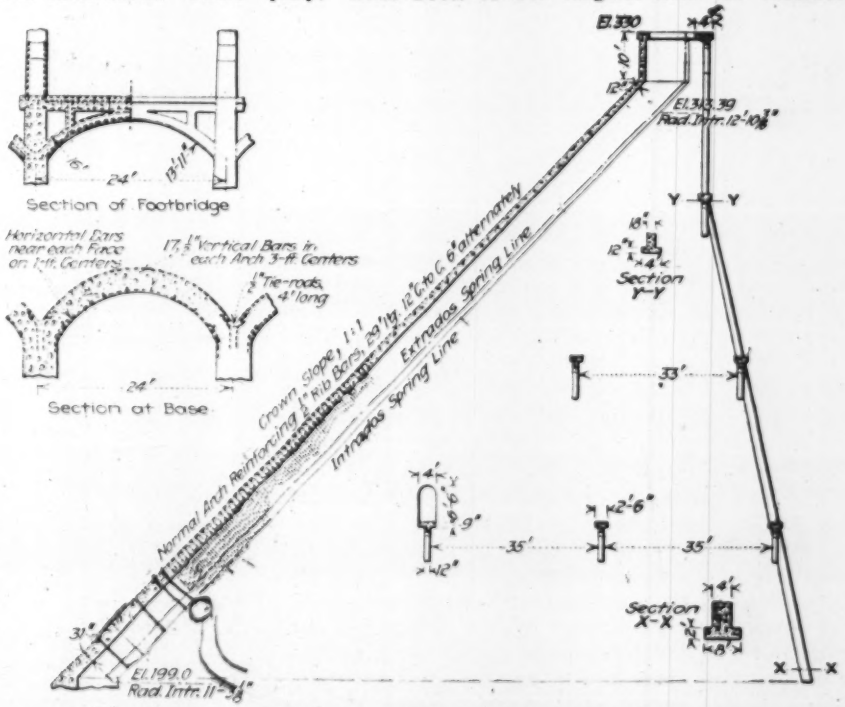
The arches vary in thickness from 2 ft. 7½ in. at the lowest point to 1 ft. at a point 50 ft. below the top of the dam, and maintain this thickness of 1 ft. to the crest, the extreme crest, however, being stiffened by means of a coping 2½ ft. wide by 1 ft. deep. The crown slope of the arches is 45°. The radius of the extrados of the slanting arches is 13 ft. 10½ in., and the radius of the intrados is variable. The reinforcement is shown on the drawing.



DOWNSTREAM FACE OF HIGHEST MULTIPLE-ARCH DAM HAS ARCHITECTURAL PRETENSION

UPSTREAM FACE OF MULTIPLE ARCHES ARE FINISHED WITH THE CEMENT GUN

The greater part of the reinforcing steel is composed of ¼-in. deformed bars. Part of the reinforcing in the spillway roll top and in the strut beams is of ⅜-in. deformed bars. In the arches the ½-in. bars are spaced 12 in. on centers on both inner and outer faces. These reinforcing bars are so alternated that the vertical space between bars in the two faces does not exceed 6 in. The arches are also reinforced with vertical rods 2 ft. on centers alternately near inner and outer faces thus giving vertical reinforcement 12 in. on centers. All steel was kept 2½ in. from the surfaces. The concrete mix in the arches was 1:2:4. The cement gun was used for putting a finishing coat on the upstream face, and has given a very satisfactory finish. The 50-ft. head of water thus far stored behind the dam did not cause any leakage through the structure. During February, 1918, a sudden flood passed through the partly finished dam over an arch that had been left about 25 ft. below the tops of the other arches. The low arch was overtopped to a depth of about 20 ft., the flow falling between the two buttresses for several days without damage. The dam was designed by John S. Eastwood, who served as consulting engineer for the company. E. A. Case was the chief engineer in charge of construction for the water company. Bent Bros. of Los Angeles held the contract.



DETAILS OF THE LAKE HODGES DAM

How Should a Federal Department of Public Works Be Organized?

Need for Clear Determination of What Bureaus Should Be Included, and How Personnel Should Be Protected and Built Up

By Charles Whiting Baker
Consulting Editor, "Engineering News-Record"

A NATIONAL convention of engineers has been called by the Engineering Council to meet in Chicago, Apr. 23-25, to formulate plans for the organization of a Federal Department of Public Works and for a campaign that will secure its creation by Congress.

That the engineering profession is undertaking a very large and difficult task, anyone who realizes the huge inertia which retards all Governmental action will agree. Even on matters of great public importance, to which there is no opposition, it is often very difficult to obtain action by Congress. If the project for a Federal Department of Public Works is to have any chance of success, it must be presented in such form that a powerful body of public sentiment can be enlisted in its support and that opposition will be aroused from as few sources as possible.

For more than forty years there has been discussion in the engineering profession as to the desirability of a Federal Department of Public Works, manned by a permanent body of civilian engineers. Seldom, however, has the discussion included the details of how such a Government department should be organized.

It is evident that if the profession desires now to carry this important reform to success, these detail questions must receive careful study. If a delegation of engineers were to appear before committees of Congress, merely to recommend that a Department of Public Works should be created, they would be assailed at once by questions: What would be the field of such a department? Which present bureaus should it take over? Would this change mean adding a new member to the Cabinet? How will the proposition affect the urgent demands which are being made by other influential interests for changes in the Federal Government organization?

The engineering profession, if it is to succeed in its ambitious task, must be prepared to answer all these and similar questions, and give convincing reasons for its answers. In the coming convention such questions as these are to be threshed out. In preparation for the discussion there, the Engineering Council has sent a prospectus to each engineering society invited to participate, in which various questions are stated, and the society is urged to consider and vote upon them.

Such general discussion by engineers is highly desirable; for, if this great reform is to be carried through engineers all over the country must be able to inform and arouse public opinion in its support.

Care is needed at the outset in defining the field which the proposed department should cover. In earlier discussions of the question it was urged that such a department should take over all the engineering work carried on by the Government. Today, however, engineering is a much more comprehensive term than it was a quarter century ago. A large part of the work done by both the Navy Department and the War Department—the construction of ships, docks, fortifications, ordnance—is engineering work of a very high order; but no one would advocate transferring such military functions to a Department of Public Works.

Again, there is a strong movement, backed by the executive heads of the railway companies, for the organization of a Federal Department of Transportation. If created, such a department would probably take over the functions of the Interstate Commerce Commission, and such other supervision over the railways as the Government may continue to exercise; the Government work in merchant shipbuilding and ship operation; perhaps also the Bureau of Navigation and the Steamboat Inspection Service, now under the Department of Commerce.

A great deal of this work is engineering work, and the Department of Transportation, if organized, should be largely conducted by engineers; but none of these functions seems properly included in a Department of Public Works. Furthermore, those promoting the establishment of a Department of Public Works may well enlist the coöperation of the influential interests backing the proposed Department of Transportation. It may be easier to bring about the systematic reorganization of the Government's business which the establishment of these two departments would involve, than to establish either department separately.

The proper field for the proposed Department of Public Works appears to be the Federal Government's operations in civil engineering construction together with the functions of those scientific bureaus which are chiefly carried on by engineers and whose work is chiefly useful as a foundation for engineering work.

In the prospectus of the Chicago conference there is given the following list of engineering bureaus scattered through various departments, with a request for an opinion as to whether each should or should not be included in the proposed Department of Public Works:

- Treasury Department:
  - Public Health Service
  - Supervising Architect
- Department of War:
  - Public Buildings and Grounds
  - Construction Division of the Army
  - Rivers and Harbors
  - Mississippi River Commission
  - California Débris Commission
- Department of the Interior:
  - General Land Office
  - Indian Affairs
  - Geological Survey
  - Reclamation Service
  - Bureau of Mines
  - National Park Service
  - Alaskan Engineering Commission
- Department of Agriculture:
  - Forest Service
  - Weather Bureau
  - Public Roads
- Department of Commerce:
  - Bureau of Standards
  - Bureau of Lighthouses
  - Coast and Geodetic Survey
- Unattached Functions:
  - The Panama Canal

That the sanitary engineers who carry on the Public Health Service, and the architects and engineers who construct public buildings, should be under an engineering department rather than the Treasury is too obvious to need argument, and the transfer of these bureaus should arise little opposition.

When it comes to the transfer to the new department of the river and harbor and other civil engineering work now carried on under the War Department by the Army engineers, no such easy success is likely. The arguments for the transfer of these works from military engineers to civil have often been presented and are familiar to most engineers. As was pointed out in discussing the question in *Engineering News-Record* of Feb. 20, p. 359, one of the strongest of these arguments is that river and harbor work, under the nominal control of the Corps of Engineers—though the policy is dictated by Congress—has become a national disgrace. This is so well known that public support should be readily enlisted in favor of the transfer of this work to the control of civilian engineers organized under a Cabinet officer who would have the authority and initiative to plan and carry out public works for the national welfare instead of merely distributing Federal expenditures in certain Congressional districts.

In the discussion of this question among engineers, first place has often been given to the position of the engineers in Government service. In pushing the reform before the public, first place must be given to the national benefit which will result from the substitution of intelligent planning by able engineers in carrying out all classes of Federal works, in place of the haphazard spending of money that has hitherto prevailed.

At the close of a war in which engineering has played so large a part, the public will look with greater favor than ever before on the proposition that the Army engineers should devote their time to military engineering work in the interest of national preparedness. To keep them busy on civil engineering work, as has been done hitherto, inevitably results in neglect of their own proper duties.

Bureaus Under Agriculture, Commerce and the Interior Departments

Of the three bureaus in the Department of Agriculture above noted, the one destined to be most important in the future is probably the Bureau of Public Roads. Already it has supervision over the heavy expenditure of the Federal Government in aid of state road construction; and much more extensive work on the nation's highways is probable. Little argument is needed to demonstrate that this should be under a Department of Public Works rather than Agriculture.

A valid reason for the inclusion of the Forest Service in the proposed department is its jurisdiction over the work of water-power development which is in prospect. It will be recalled that the Federal water-power bill, which came so near passage in the late Congress and for which success is expected in the coming session, created a Water-Power Commission made up of the Secretaries of the Interior and Agriculture Departments and of War, because the bureaus concerned with water-power were scattered through these three departments. If these bureaus are brought together in a Department of Public Works, the need for such a cumbrous administrative organization will disappear.

Perhaps the Agricultural Department will seek to retain the Weather Bureau; but its relation to the engineer's work for flood control, water-supply and irrigation is close enough to ground an argument for its inclusion in the Public Works Department.

Of the three bureaus under the Commerce Department listed above, the building of lighthouses and the work of the Coast and Geodetic Survey would surely be generally recognized as civil engineering functions. As for the Bureau of Standards, its work is so largely carried on by engineers and for engineers that the proper place for it would seem to be in the department which will be presumably the engineering department of the Government.

Under the Interior Department, seven bureaus are listed above for possible transfer to the Department of Public Works. In answer to the objection that this would practically destroy the Department, leaving it only patents, pensions and education, the National Service Committee of the Engineering Council has made the interesting suggestion that the Department of Public Works could most easily be started by merely changing the name of the Interior Department, the latter a name which has no longer any significance. This would obviate also the creation of a new Cabinet office.

Of the seven bureaus in the Interior Department listed above, the Reclamation Service of course belongs in a Department of Public Works and so does the work of building the Alaskan railroads. The Geological Survey should be under the same head as the Coast and Geodetic Survey, and as the Bureau of Mines. The care of the national parks should be in the same department as the care of the national forest reserves. The Land Office and the Indian Bureau have such close relations with the other bureaus just named that they should be retained.

Organization of Department

Turning now to the organization of the proposed department: The profession will surely agree that the engineers in such a department should be given a permanent status. These men, on whose independent judgment the conduct of the department will depend, must be safeguarded from dismissal through political or personal influence. If the Government's work is to be carried on with economy and efficiency, unprejudiced engineering judgment is a first essential. Some reasonable tenure of position for engineers in the department is necessary for this reason, and it is also necessary in order that engineers of the requisite ability and character may be obtained. If engineers must exert political influence to obtain positions in the service and hold them after obtaining them, there is little chance that the Government would be able to secure for its great tasks such engineers as have built up the railway systems of the country or created its great industrial establishments.

Hardly less essential in planning the personnel of the proposed department is provision for regular promotion and for retirement on partial pay on reaching a certain age limit on becoming disabled in the service. It is hardly to be exected that Congress can be persuaded to increase the salaries for technical and professional men in the service of the Government to the scale common in private business. There is a fair prospect, however, that Congress will, eventually, in view of the urgent necessities of the departments at Washington,

provide a retiring allowance for Government employees at a certain age limit. With secure provision for old age or disability, men will be better content to work at the low scale of salaries common in the Government service.

It may be argued that such a corps of civilian engineers as is here proposed, with a fixed tenure of office, definite provision for promotion and retiring allowances on reaching the age limit, would to some extent duplicate the organization of the present Corps of Engineers. It has, nevertheless, great advantages over that organization in its freedom from military control and military methods. It would be recruited, also, from men trained in the engineering schools and probably also by some years in the school of practical experience, instead of being brought into the work fresh from West Point.

It needs only a glance, too, at the varied kinds of work which this great department would have to execute to see how necessary in such an organization would be engineers of a great variety of experience, experts in their respective fields. It is only by enlisting the service of such men that the Government can hope to have its great works carried out efficiently.

But, in carrying out any great reform, it is well not to attempt too much at the start. Fundamental though the internal organization of such a department may seem to be to its success, those who have planned the Chicago conference give warning of difficulties in the way. The various bureaus which it is proposed to bring together in that new department each have their own organizations, methods, and personnel which have been built up through a course of years, and to a considerable extent are covered by special laws. If it were attempted now to make a sweeping reorganization of these bureaus, as well as transfer them to a new department, strong opposition would certainly be encountered. Moreover, the bill to create the new department would have to be a very long and complex statute repealing a large number of existing laws and enacting other provisions in their place. It is easy to foresee that such a law would be carried through Congress with great difficulty, if at all.

If the proposed Department of Public Works is to become a reality, therefore, the wisest plan would appear to be merely to bring together intact such bureaus as manifestly belong under such a department, with practically no change in their present organization and personnel. The working out of the relations between these bureaus and of the general organization of the department could be left for the future.

Upkeep High on Disconnected Road System

MAINTENANCE of the 700 miles of state-aid roads of Illinois is difficult and expensive, because the system is so disconnected. The longest continuous stretch of improved road is 15 miles, and the average length is less than two miles. About 300 miles are earth road and the remainder are principally of brick and concrete. The costs per year per mile, including work on the shoulders and ditches, average: Brick, $56.56; concrete, $81.45; earth, $102.20; gravel, $162.20; macadam, $564.20 (including surface oiling). Maintenance work on brick and concrete paving consists mainly in filling cracks and building up the earth shoulders; on macadam paving it is mainly surface treatment, while on earth and gravel roads it consists of dragging and filling depressions with new material. In addition, there are the cutting of weeds, the clearing of ditches and the dressing of the shoulders. Where the gang system of maintenance is used, each gang, composed of two to five men in charge of a foreman, takes care of the work in from 10 to 15 counties and has about 75 miles of road under its charge.

The equipment used consists of a small motor truck, heating kettles and the necessary tools and accessories. Only in Vermilion County has the patrol system been introduced, this being made practicable by the fact that there are 90 miles of hard road, the greatest mileage in any one county.

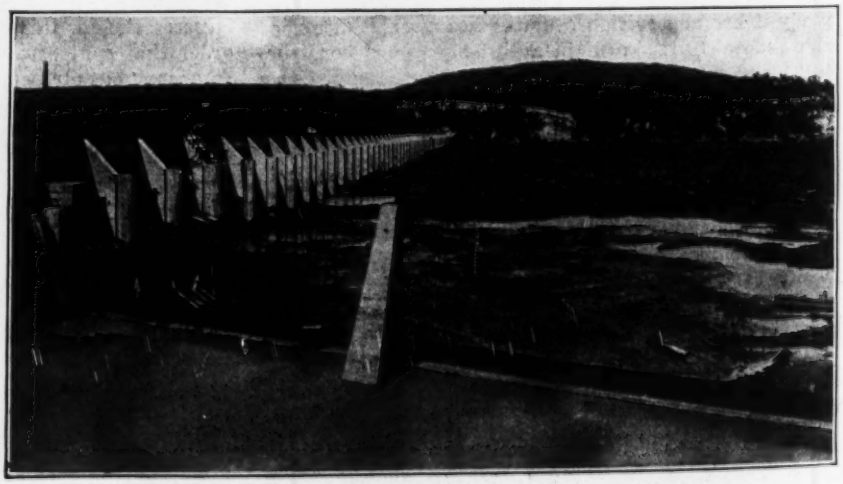
Drift on the Colorado River Held Back by Austin Dam

Passes Over the Rounded Top of Old Dam, But Is Caught by the Present Structure—All Sorts and Sizes of Débris

By T. U. Taylor
University of Texas, Austin

ENGINEERS unacquainted with the Colorado River, Texas, do not appreciate the seriousness of the drift problem in its relation to the Austin dam. The accompanying view, showing drift conditions in the spring of the year, will help them understand what has to be contended with, besides emphasizing the importance of designing a dam to meet local conditions.

The drainage area above the dam at Austin, Tex., is 37,000 square miles. There is an immense amount of drift that comes down the Colorado River, and this



NEW AUSTIN DAM CATCHES VAST QUANTITIES OF DRIFT

drift will be stopped by, passed over or around any dam across the stream.

During the existence of the old dam the drift passed over the rounded crest with no practical difficulty. In 1911, when the City of Austin was considering the present style of dam, it was warned of the futility of depending on it to pass the drift. This warning was ignored, and the contract was let for an open-work dam with a crest in the new part at El. 51 ft., with gates 14 ft. high between buttresses which were supposed to raise the water to El. 65 ft. above the toe of the old dam. There were 28 of these gates, and the first drift flood that came after they were installed destroyed 24 of them and clogged up the gateways with drift.

The accompanying view was taken by the writer when the lake level was 54 ft. above the toe of the dam. It was taken from the east end of the dam, looking toward the west. From the lone buttress or pier in the foreground to the west bluff is practically 1200 ft. The small patches of water seen in the foreground are the result of pulling drift out of the east gate sections. The drift ranges in size from mere trash to logs 3 ft. in diameter, and 60 ft. long.

It should be remarked that there is another dam at Marble Falls, about 120 miles, by river, above the Austin dam, and that the Marble Falls dam partially obstructs the channel and stops considerable drift.

Planning Work Expedites Casing of Pipe Line With Concrete

In Repairing Oil Line Different Foremen Directed Materials Supply, Plant Repairs and Principal Construction Operations

PLANT mobility and precise scheduling of operations have enabled the construction forces of the Standard Oil Co. to obtain notable speed in casing a steel pipe line with concrete. Working 131 men in a gang, 280 miles of 8-in. line in Louisiana have been concreted at an average speed of one-third mile per gang per day. The gangs were divided into crews under foremen and subforemen, and each crew performed a specified set of operations in step with the other crews. Easily shifted tent camps kept the gangs close to their work. All equipment was portable, and certain units less movable than the others were provided in duplicate, so that one unit could be moved ahead and set up ready for work while the other unit was busy on the preceding section. Materials delivery was timed exactly with the work.

Corrosion of the six-year-old oil pipe line between Ida, La., and North Baton Rouge, La., made concrete casing necessary. The terrain traversed by the line is generally low and flat, with a large percentage of marsh land and swamps and some rolling hills. Chlorine salts and other acidulated solutions in the soil had pitted the pipe; in places the pitting was severe. The work to be done involved more than simply placing a concrete casing. It was necessary to uncover the lines, hoist and hold the pipe above the trench bottom, pound, scrape, brush and otherwise clean the pipe, and then to lower and encase the pipe and backfill the trench. All these operations had, moreover, to be performed while the pipe was carrying oil under pressures of from 100 to 600 pounds.

At times one superintendent directed the field operations of as many as four gangs. Each gang consisted of 125 laborers and six foremen. The laborers were apportioned about as follows: Forty men uncovering, handling and backfilling pipe line; 20 men cleaning pipe; 50 men concreting; 10 men handling materials and equipment, and five utility men. Subdivision of the duties of the foremen was carefully planned. There were two materials foremen, three ditching foremen and two concreting foremen, each having a set schedule.

The direction of materials supply was kept separate from the direction of construction operations. A materials foreman, generally one for every two gangs, designated the distribution points, investigated roads, and routed and placed materials and supplies along the work. On the work an assistant foreman, one for each gang, directed the unloading, looked after the housing of cement and the salvage of cement sacks, and saw generally that all things were done which were necessary

CONCRETE WAS WHEELED FIFTY FEET EACH WAY FROM LOCATION OF THE MIXER

PIPE-LINE CREW SHIFTING HORSES AND SETTING FORMS

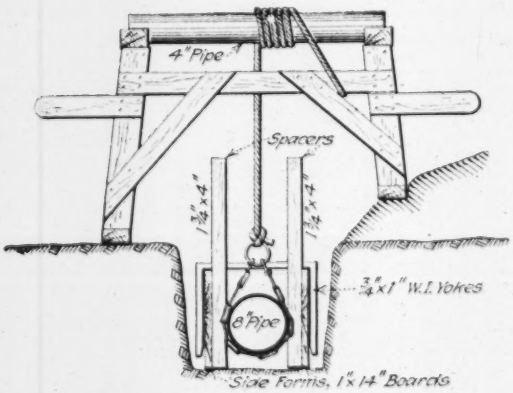
to keep the construction foremen promptly supplied with materials, supplies and equipment.

The transportation of materials was somewhat simplified by the fact that the pipe-line work paralleled railways to a considerable degree. Sand, cement, lumber and equipment were shipped by railway in carload lots to stations nearest the work, and from these points were hauled to and distributed along the work by teams. Water-supply was a more complex task. The amount of water required for concrete mixing and for drinking and cooking was quite large. This water was hauled in tank wagons from convenient bayous, creeks and wells from which it was pumped by portable diaphragm pumps. Horizontal, galvanized-iron, 5- and 10-bbl. tanks were used, the larger or the smaller being employed according to the character of the roads. Cross baffle plates in the tanks prevented the surge of the water when the roads were rough. The tank wagons discharged into barrels located were the water was wanted.

The preparation of the pipe line for the concreting operations was in charge of a general foreman and two assistant foremen. The general foreman directed the operations of uncovering and of raising and lowering the pipe. One assistant supervised the pipe cleaning and the other directed the backfilling and the finishing up of work of various kinds.

After being uncovered, from 200 to 300 ft. of pipe at a time was hoisted by means of windlass horses to a height which permitted the leveling of the trench bottom and the thorough cleaning of the pipe. When cleaned, the pipe was lowered to a position 2 in. above the trench bottom, and concreting was begun.

Cement mortar, nominally of 1:3 mixture, was used for the casing. However, the purpose was to insure a mixture in which the volume of cement was always great enough to fill the sand voids, so the nominal proportions were changed whenever tests, which were constantly made, indicated material variation in the void contents of the sand. Experience has shown this mixture to be practically waterproof. The thickness of the casing was 2 in. under the pipe bottom, $1\frac{3}{4}$ in. on each side, and 1 in. over the top, which was shaped to a flat crown. No bottom forms were used except where the bottom was boggy or where there was a small water crossing. This practice greatly reduced the amount of lumber left in the trench. The side forms were 1 x 14 in. x 16-ft. boards, cleated across at the middle and at each end to prevent splitting. They were set on edge on the trench bottom and were held in position by wrought-iron clamps spaced about 4 ft., and by timber spacers which blocked them away from the pipe. This arrangement, as shown by the drawing, insured the proper thickness of covering and the exact centering of the



WINDLASS HORSES HELD PIPE LINE SUSPENDED WHILE BEING CONCRETED

INCASED PIPE LEFT IN FORMS OVER NIGHT TO HARDEN

pipe in the forms. The butt joints in the side forms were banked outside with clay to prevent leakage of mortar.

The concrete was machine-mixed and was placed with wheelbarrows having side spouts to facilitate pouring into forms. Stock piles were placed at every tenth joint of the pipe line, or 100 ft. apart, so that the maximum wheelbarrow haul of concrete was 50 ft. ahead and 50 ft. to the rear. Wheel-mounted, ½-cu.yd., power-driven mixers were used. They were hauled by four-mule teams. Two mixers were provided for each gang, one being in use while the other was being hauled ahead and set up ready for use as the work advanced.

Concrete was placed with the pipe suspended, as shown by the sketch. Careful puddling was necessary to fill solidly under the pipe, but otherwise the work presented no special difficulties. When a 100-ft. length of pipe had been concreted and the corresponding length ahead had been suspended in position for concreting, the slings holding the concreted length were released, letting the pipe "float" in the green concrete. No squeezing up or settlement of the concrete resulted from this procedure. The holes left by removing the slings and spacers were filled, and each morning the side forms were removed from the previous day's work.

A construction foreman and a machinery foreman directed the concreting operations. All work of lining up the steel pipe, moving and placing forms and mixing and placing concrete was in charge of the construction foreman. His assistant attended to the upkeep and repairs of mixers, motors and other equipment, and saw to the shifting and setting up of the extra mixer.

All construction was under the direction of the pipeline department of the Standard Oil Co. of Louisiana. Information for this article was furnished by F. Ray McGrew, assistant superintendent.

Piecework Faster Than Day Labor On Hand Excavation

Greater Yardage per Man Recorded in California on Both Road and Irrigation Work—Station Gangs Used on Piecework

By Everett N. Bryan

Chief Engineer, Waterford Irrigation District, Waterford, Calif.

YARDAGE output per man in excavating for road construction in California was 10.9 cu.yd. and 14.3 cu.yd. by piecework, compared with 6.8 cu.yd. and 10.9 cu.yd. by force account. On excavation for irrigation structures, the piecework output per man was 7.2 cu.yd., as compared with a best record of 6.3 cu.yd. by force account. In both comparisons the conditions favored more rapid excavation on the force-account jobs.

The road excavation amounted to 59,027 cu.yd. of loam, "dobe" and cemented gravel, containing in places large percentages of loose rock. Loosening by blasting was necessary to get the best results. All excavation was pick and shovel work, and the material was loaded into cars.

The force-account excavation amounted to 12,283 cu.yd. One cut of 9000 cu.yd. had a maximum depth of 25 ft. This was handled by driving a center drift at the bottom and trapping as much as possible of the mate-bottom and trapping as much as possible of the material into cars. The excavation in the smaller cuts was shoveled. Competent foremen were in charge in all cases. The average output, including drilling, blasting, drifting, mucking, transporting and dumping was 6.8 cu.yd. per man per day. Counting labor in drifting and mucking alone, the output per man per day was 10.9 cubic yards.

Nine station gangs excavated the remaining 46,744 cu.yd. Part of the material was trapped into cars in center drifts at the bottoms of the deeper excavations, part was trapped into cars beneath lean-to platforms against the faces of the excavation, but the larger part was shoveled directly into the cars. Generally, the conditions were not so favorable to rapid progress as they were in the 12,280 cu.yd. of excavation that was done by force account.

The output per man per day for the nine gangs was, however, 10.9 cu.yd., including all operations, and 14.3 cu.yd., including only labor in drifting and mucking.

In excavating for irrigation structures the force-account operations were divided into two parts. About 1339 cu.yd. of excavation was for 28 canal structures and was contained in pits not over 30 in. wide, which were shallow enough to be dug without reshoveling. There was some hardpan in the pit bottoms and the top soil had to be loosened by picking. Very little blasting was necessary. The average output was 2.94 cu.yd. per man per day. The second part of the force-account excavation consisted of trenches for five inverted siphons, and amounted to 1019 cu.yd. The material was not inconvenient to handle, there being very little cemented gravel requiring blasting. The output was 6.3 cu.yd. per man per day.

Piecework Contracts for Trenching Siphons

On another part of the work piecework contracts were let for the trenching for three more inverted siphons. The excavation amounted to 2469 cu.yd., of which 2218 cu.yd. were in one trench 4½ ft. wide and averaging 5½ ft. deep. The other two trenches were of smaller cross-section, the smallest one being 2.25 ft. wide and averaging 3.2 ft. in depth. The smallest trench was very hard at one end and required blasting; the middle-sized trench was handled entirely without powder, and the largest trench required the use of powder throughout. An average of 0.69 lb. of powder per cubic yard was used, and the bottom was carefully trimmed with picks to leave a smooth surface on which to lay the concrete pipe. The average progress per man per day, including drilling, shooting, picking, shoveling, and forge work, was 7.8 cubic yards.

In some cases it is not practicable to compensate an entire gang on a piece-rate basis, but it is often possible to engage one or more of the men to undertake the work on such a basis, if the employer will pay wages to the other men and deduct the cost thereof from the total sum earned by the gang. This plan is applicable to many lines of work where the total cost is not sufficient to justify an attempt to let contracts in the usual way. The work requires less watching than when done by day labor, and is generally accomplished with greater satisfaction to both employer and employee.

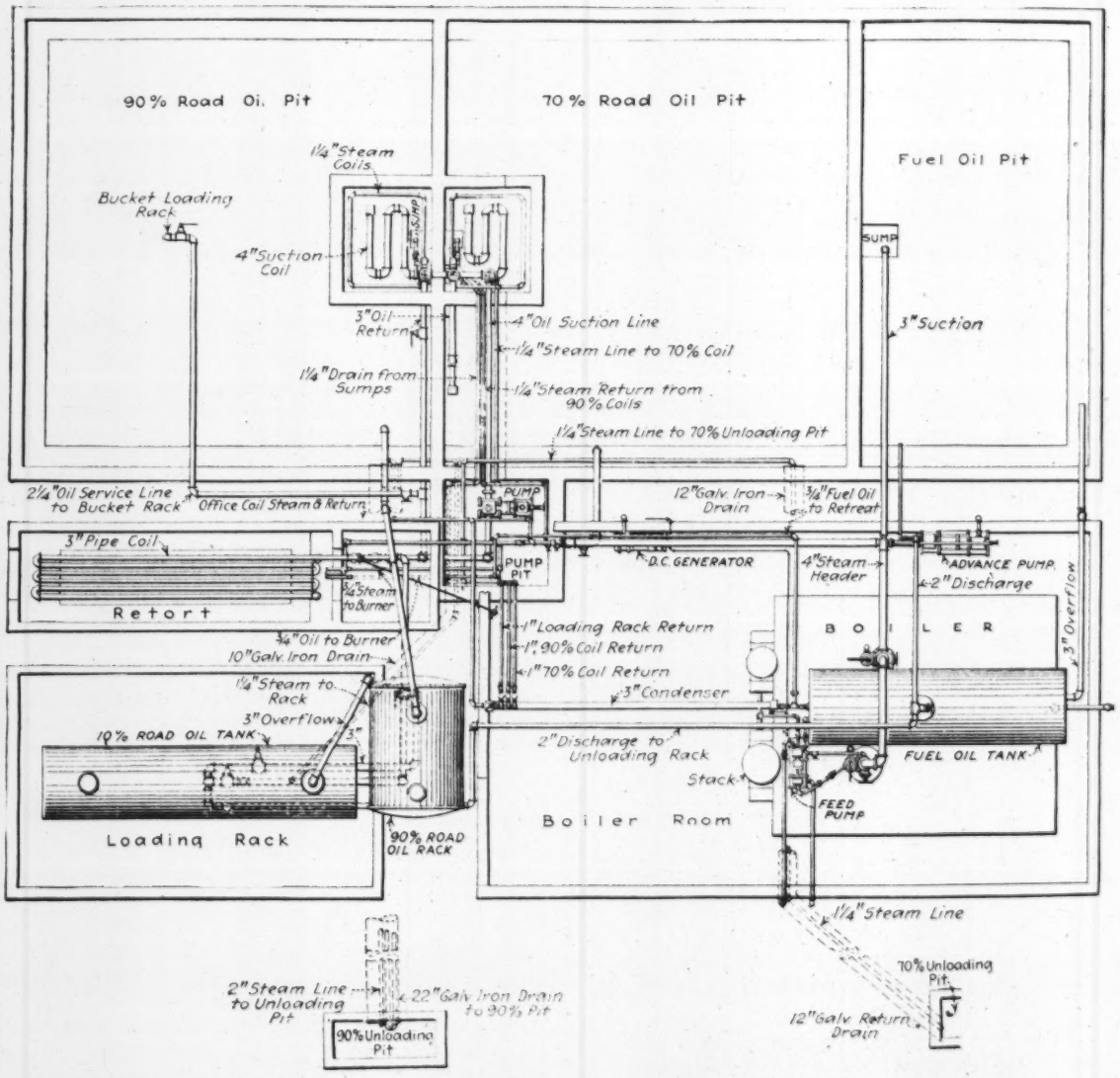
Road-Oil Heating Plant of Los Angeles County

Road Department Builds Plant from Old Equipment in Stock—Installation Saves County $20 per 1000-Gallon Tank

By E. Earl Glass
Monrovia, Calif.

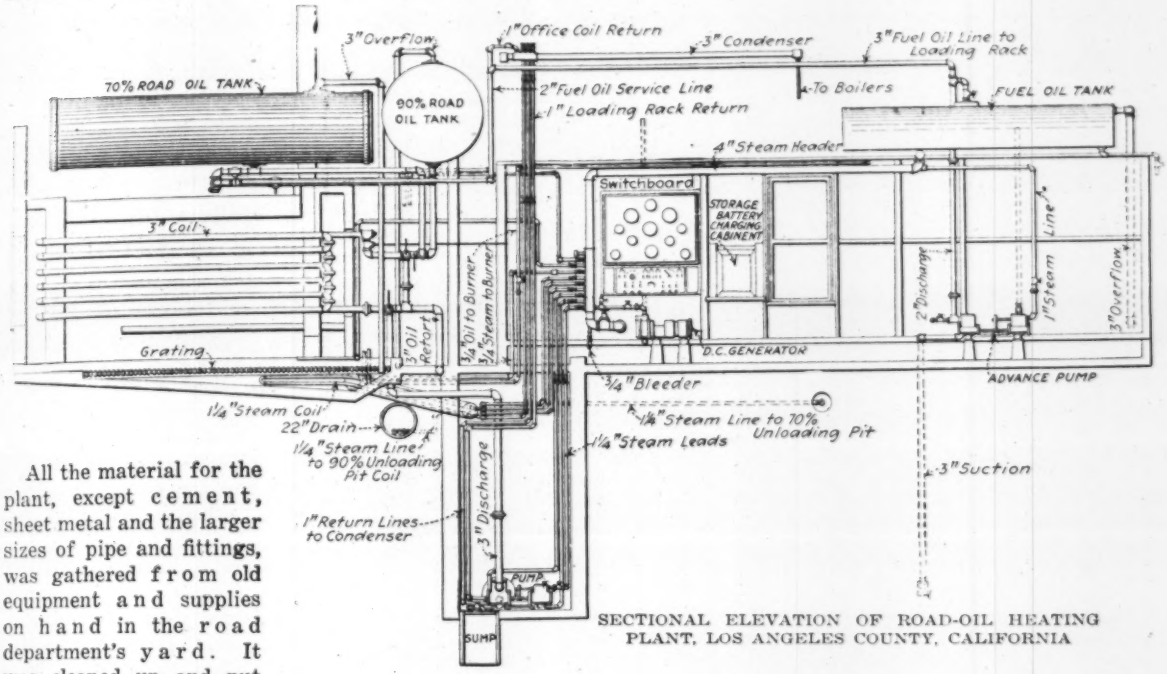
A ROAD-OIL heating plant built from old equipment in the stock of the Los Angeles County road department has been very successful. A saving of $16.66 in delivery and of $1.32 in heating and loading per 1000-gal. tank, as compared with the rates of private companies, has been effected by the installation. The cost per barrel-mile of spreading on the road has been reduced from 3.5c. to 1.68c.—a net saving of 1.82c. From 8000 to 10,000 gal. of oil per day, depending upon its gravity, can be handled, and when operating at capacity the cost averages $1.35 per 1000 gallons.

Large quantities of natural asphalt oil are used in the construction of roads in California, and the county officials found they could effect a considerable saving by handling the oil themselves. The new plant was located, centrally, in the eastern part of the county, at the Baldwin Park warehouse, which is distant 25 miles from the old source of supply. A 20-mile delivery trip, on the average, for each tank of oil used in the district, was thus eliminated. Since the private companies charge 3½c. per barrel-mile (one-way charge) for delivering and spreading, the road department saves $16.66 on each 1000-gal. tank of oil. A further saving is also effected in delivering and spreading, as shown by actual operations. A county truck can average 66 miles per eight-hour day, or 33 miles one way. With a truck driver at $4 per day, a truck helper at $3.50 per day, gasoline and oil at $2.50 per day and interest, depreciation and repair at $3 per day, this gives a total of $13 per eight-hour day, or 1.68c. per barrel-mile, as compared with the commercial rate of 3½ cents.



PLAN

ROAD-OIL HEATING PLANT BUILT FROM EQUIPMENT IN STOCK AT A COST OF $6000



SECTIONAL ELEVATION OF ROAD-OIL HEATING PLANT, LOS ANGELES COUNTY, CALIFORNIA

All the material for the plant, except cement, sheet metal and the larger sizes of pipe and fittings, was gathered from old equipment and supplies on hand in the road department's yard. It was cleaned up and put in good order, so that the finished plant does not show its origin in either performance or appearance. Plans and elevation are shown in the accompanying drawings.

Excavation for the pits required the removal of about 1500 cu.yd. of clean gravel, which was used to level the warehouse ground, the select gravel being used as a natural aggregate for the concrete of the pit floor and walls. The plant has three oil compartments in the storage pit, two of three-car capacity for the heavy 90% and medium 70% oils, and one of two-car capacity for fuel oil. They are filled by gravity, from railroad tank cars, through 22-in., 12-in. and 6-in. drains, running from the three unloading pits, which are situated between the rails on the siding and are spaced 45 ft. on centers. A flowing temperature is maintained in the two large drains and their track pits by means of the steam-pipe coils with which they are fitted. The track pits are 2 x 6 x 2½ ft. deep, with 6-in. concrete walls and floors.

At normal temperature, the 90% oil has about the consistency of slightly warm tar, while the 70% oil is somewhat more fluid. The former is used for the construction of bituminous macadam roads, for the wearing coat on concrete highways and for all patching and repairs on these roads. The 70% oil is used almost exclusively by the road foremen for the construction and repair of the oiled-earth roads, which include most of the secondary roads in southern California.

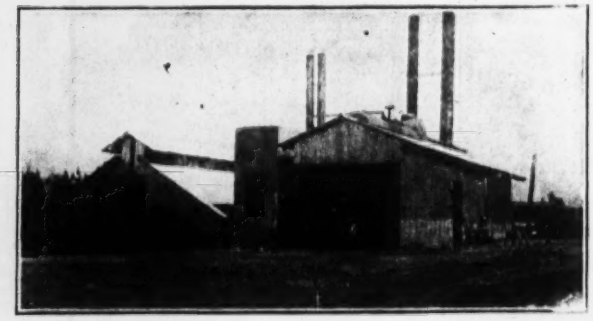
A 12,000-gal. car of the heavy oil is unloaded in seven to ten hours, depending on the time which has elapsed since the car was loaded hot. Two hours' time is required to empty a car of 70% oil. Steam for the car coils, track pits and drains is furnished by two boilers of 35 and 50 hp., the 13-way manifold on the steam header being made in the warehouse shop with an acetylene welding outfit. The boilers also supply steam for operating the pumps, oil burners, heating pit coils and heating system for the warehouse office. Either boiler is capable of running the plant at capacity. Compressed air from the warehouse is used to start the oil burners under the boilers. A 1-kw. steam-turbine direct-current generator unit supplies the current for charging the storage batteries for the trucks and automobiles. A drop-leg condenser automatically returns the condensed steam to the boilers.

A sawdust mixture was used successfully for covering the steampipes, but was not suitable for the oil lines, as it takes fire at high temperatures. In making this mixture 2 lb. of wheat starch and 1 lb. of rye starch were cooked to make 5 gal. of paste, and enough sawdust was stirred in to make 10 gal. of mixture. This was spread on canvas strips and wound on the pipe, and then heated to dryness by turning on the steam. When a coat of boiler paint is applied, this treatment gives good results and a fair appearance.

The retort is entirely inclosed by a 6-in. concrete fire wall, carried well above the surrounding buildings and kept out of contact with the brickwork of the retort by a thin plaster of mud, to allow for expansion of the brick. The firebox is lined with firebrick and heated by an oil burner. The 3-in. retort coil has 430 sq. ft. of heating surface, and all the return fittings are readily accessible for the removal of burned pipes. The coil pipes, 2 in. in diameter, extend through pipe sleeves in the end walls of the firebox into the return chamber, and the coil supports are kept fully air-cooled, resisting the high temperatures by passing through 4-in. casings extending through both side walls.

The loading room has a floor of 2 x 4-in. pine grating over a shallow concrete pit which drains through a coil-heated pipe to the 70% compartment. The delivery trucks back upon this rack and are loaded from above through a universal nozzle. Any one of the three grades of oil may be drawn from its overhead storage tank by

the operation of one of the three valves on the service lines at the nozzle. The entrance to the loading rack is closed by a roller door made by nailing narrow Oregon pine ceiling to three pieces of canvas belt. The oil pit is roofed and the other buildings are sided with gal-



LOADING TRUCKS AT ROAD-OIL HEATING PLANT

vanized sheet metal. The illustration shows a truck loading in the shed.

In operation the asphalt oil is admitted to the 5 x 6-ft. cell, and rises to the depth of 6 ft. This cell has the capacity of a 1000-gal. truck. The 1¼-in. pipe steam coils raise this from normal temperature to 150° F. in about one hour. It is now fluid and is raised through the retort to its overhead tank by the duplex steam pump in the pit below the boiler room. The 4-in. suction pipes in the heating pits are jointed and balanced, so that the hot oil may be drawn from the surface. The efficiency of the heating pits is being further increased by the laying of flat steam coils on their floors.

A 1-in. metallic hose is connected to the line between the 90% pit and the retort and is used to fill 4-gal. steel buckets with heavy oil. Highway maintenance crews use these to carry patching oil on their tool trucks. As more than 200 of these buckets are used each day, this method is much more effective than carrying the buckets from a fixed filling pipe, as was done in the past. All oil pipes drain back when not in use to prevent setting of the asphaltic oil in the cold pipes. Each of the overhead storage tanks is fitted with an overflow pipe returning to its proper pit.

Fuel oil (27 gravity) is pumped directly from its pit to the 550-gal. supply tank over the boilers, whence it flows to the burners of the retort and boilers and to the service nozzle over the loading rack. This oil is delivered to the county road rollers, steam shovels and pile-drivers by truck tanks or trailer tenders.

Oil temperatures are indicated by an electric pyrometer, calibrated from 0 to 800° F. Five thermo-couples are fixed at the following points: One in each heating pit, one in each road oil tank and one in the retort coil. These lead through a selective switch to the indicator. Regulation of the circulation of the oil through the retort, and thereby of the temperature of the road oil, is controlled by a gate valve which is operated from the switchboard by an extension stem and hand wheel. This gives a practically centralized control of the plant and makes one-man operation possible. The cost of operation is $7.50 for fuel, lubricant and water, and $4.50 for the operator, or $12 per eight-hour day. Ten 1000-gal. tanks of 70% oil at 300° F. or eight 1000-gal. tanks of 90% oil at 350° F., can be loaded in eight hours.

The full capacity of the plant will seldom be called upon, but an average of five truckloads per day may be expected. This will give a cost of about $2.25 each, for heating and loading. The cost of the plant was about $6000. It is being operated under the supervision of F. H. Joyner, county road commissioner.

Inclined Railway to Deliver Materials on Hetch Hetchy Project

DELIVERING materials and equipment to the Early intake portal of the 18-mile tunnel on the Hetch Hetchy water-supply project required special consideration because the intake is in a narrow cañon about 1700 ft. below the Hetch Hetchy Railroad. The method decided upon was the use of an inclined tramway 3000 ft. long with a maximum incline of 70%. This tramway was built in 1917.

1700-FOOT INCLINE TO EARLY INTAKE PORTAL

To prevent creeping anchorages were put in as close together as the outcropping of rock afforded suitable foundation. These anchorages consisted each of an extra large tie, usually a 14 x 14-in. timber, cut as long as necessary to develop the strength of the anchorage. Where the rails crossed these anchor ties the flanges were notched so that the spikes could prevent creeping of the rails over the tie. Twenty-pound rails were used.

No measurements have been made of the lengthening that has occurred in this rail line since it was installed a year and a half ago, but the resident engineer asserts this has amounted to as much as 6 or 8 in. An interesting point is that the resultant movement is downward, whether caused by contraction or expansion.

When the incline is ready for operation a 25-hp. electric winch will handle the cars. In the meantime, the only access to the bottom of the cañon is by means of a wagon road built on a uniform 10% grade, and about 3½ miles long.

Midway in the line (near the top of the accompanying view) there is a turnout. Three rails instead of two were used on the incline to insure against derailments at the turnout, which, experience proves, are of frequent occurrence where only two rails are used.

This work is being carried out by the City of San Francisco under the direction of M. M. O'Shaughnessy, city engineer.

More Water Laboratories in Kansas

Water-works managers in a number of the smaller Kansas cities are fitting up small chemical and bacterial laboratories. The practice is being promoted by the State Board of Health, which will supplement the work of these small laboratories by more extensive analyses made periodically in its main laboratory.

Water Consumption Cut More Than Half at Newark, Ohio

Contract for Water-Waste Survey Reduced Underground Leakage and Located Illegal Use of Water

By F. H. Waring
Assistant Engineer, Ohio State Department of Health, Columbus, Ohio

WATER-WASTE surveys cut waste and consumption at Newark, Ohio, more than half, or from 131 to 61.5 gal., in 1918. Much of the excessive consumption was due to the illegal use of water, and much to underground leakage. The curtailment was effected by professional water savers, working under contracts in coöperation with the city water department.

The population of Newark in 1918 was estimated at 30,000. The water-supply is pumped from infiltration systems in the bed of the north fork of the Licking River, supplemented from the river direct. Liquid chlorine disinfection is used. Up to Mar. 1, 1918, the city water-works was conducted under the immediate supervision of the director of public service, J. Edward Wilson, who then appointed Taylor Kussmaul superintendent. The latter had been engineer at the pumping station and later assistant in the office of the water-works department.

The water consumption at Newark averaged about 3,000,000 gal. a day for the four-year period up to January, 1917. Subsequent steady increase in water consumption took place, until in the spring and summer of 1918 it had reached the estimated figure of 4,100,000 gal. per day. On Mar. 1, 1918, 6700 of the 7000 services were metered.

In attempting to account for water consumed, the superintendent observed: (1) That the water consumption estimate of 137 gal. per capita was excessive for a city of the size and character of Newark; (2) that he could account for but a small percentage of the total water consumed by checking up the 96% of services that were metered; (3) that an average daily pumpage of over 4,000,000 gal. placed a burden on the pumping station which would soon have to be met by the installation of a new pump at a considerable expense to the city. It was the superintendent's purpose, therefore, to find out if the purchase of such an additional pump was necessary.

On July 1, 1918, every service had been metered, and still the large quantity of water consumed was unaccounted for. On Aug. 1 a water-waste survey company was employed to make a survey of the distributing system. At the suggestion of the superintendent the employment of the comapny was not made generally public.

Contract for Waste Survey Made

The survey experts contracted to test (1) the existing pumps; (2) all meters larger than 3 in. (3) the distribution system, for underground leakage. It was agreed that the leaks, as located, would be repaired and that tests would be made at industrial plants to detect any illegal use of water.

The company furnished one engineer and three pitometers; the city furnished shelter boxes for the instruments, a foreman and three laborers for line work, necessary transportation and incidentals. The company guaranteed to save the cost of the survey to the city by accounting for and stopping leakage of water which would be figured for one year at 3c. per 1000 gal. The city agreed to pay one-third of the contract price when the guarantee was fulfilled, one-third when the field work was completed, and one-third when the report was filed and accepted. The contract price to the city under the above conditions was $2600. It is estimated that the city incurred expenses connected with the survey amounting to $2600 more.

Pump tests indicated slippage as high as 14½% when the pumps were drawing water direct from the Licking River. Repairs were made and the second test indicated 10% slippage. Further repairs were undertaken, but the exact amount of slippage then prevailing was not determined before the survey was finished. Having installed measurement devices for the total quantity of water pumped, the average daily consumption in August was found to be 120 gal. per capita. This figure was far in excess of what it should be for a totally metered city of 30,000.

The city was then divided into districts, and the water consumed in each district was measured for a 24-hour period. If comparison of the day and night rates showed the latter to be a high proportion, indicating waste, the district was subdivided and the same 24-hour study was made. In this way leakages were narrowed down and located, and the necessary repairs were made at once.

Illegal Use of Nearly 1,000,000 Gallons Found

In the course of the survey the experts located an illegal use of water by the American Bottle Co. amounting to about 895,000 gal. per day. This water was being taken through an unauthorized connection to a fire line which entered the property from a 12-in. city main. The connection was uncovered and photographs of it were obtained. The company disclaimed any knowledge of the connection, although water had been drawn through it regularly for cooling purposes in its factory. This and other evidence enabled the city to bring charges against the bottle company. A bill for $49,000, estimated to cover the amount due the city for 1918, was rendered. On refusal to pay the bill the city threatened to shut off the bottle company's entire supply, and the company brought suit to enjoin the city from carrying out its threat. The company offered to settle for $6700, representing that the evidence at hand proved only the definite illegal use for a short time preceding the survey. The trial court sustained the company and gave the city judgment for $6700. The city has taken the case to a higher court.

During August, after the shut-off of the illegal connection at the American Bottle Co., the average daily quantity of water accounted for by the meters from which revenue is received amounted to 909,700 gal. Other consumption was: Flat-rate services for commercial use, 379,000 gal daily; public watering troughs, 99,000; hydrant leakage, which could be stopped after repairs had been made, amounted to 82,000 gal. A total of 1,469,700 gal. a day was accounted for.

At this time a remeasurement showed that 1,845,000 gal. was being pumped to the city. Of the difference, amounting to 375,300 gal., 243,000 gal. was attributed to unavoidable leakage, or 3000 gal. per mile for the 81 miles of main in the city. The remainder, 132,300 gal., was assumed to be consumption by the city building and fire houses and the city hospital. The second as-

sumption was thought to be too low, but, nevertheless, showed forcibly the fact that the main leakage had been reduced to a minimum.

Recapitulation of the average daily consumption shows the following comparative totals:

	Gallons
Before the survey	3,932,000
After the survey	1,845,000
Decrease	2,087,000
Leakage located and stopped	552,000
American Bottle Co. illegal use stopped	895,000
Decrease unaccounted for	640,000

Of the decrease unaccounted for, about 140,000 gal. were attributed to two leaks that were subsequently discovered and repaired by the city on the supply main, leaving 500,000 gal. unaccounted for.

It is felt by the survey experts and by the city officials engaged on the work that this item represents a large consumer taking water illegally from the mains, but whose connection could not be located following the exposure of the American Bottle Co. In other words, the large consumer became aware that investigations were being made and discontinued taking this amount of water just before the survey was finished.

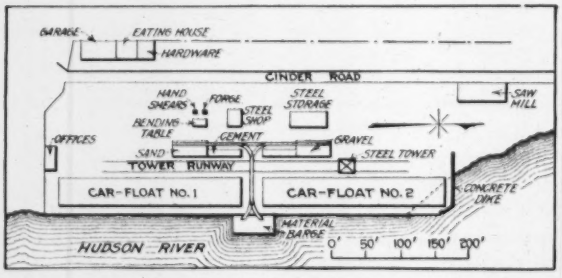
The water-waste survey at Newark revealed the fact that before the survey the average daily per capita consumption amounted to about 131 gal. After the survey, and after leakages had been repaired and illegal use of water stopped, the per capita consumption fell to 61.5 gal. The leakage amounted to 23.1 gal. and the illegal use to 29.8 gal.; unaccounted for but stopped, and thought to be additional illegal use of water, 16.6 gal. per capita. In other words, the City of Newark has accomplished a reduction in water used, and for which previously no revenue had been derived, corresponding to 53% of the total water pumped before the survey. It is needless to add that an additional pump was therefore found to be unnecessary. Furthermore, the plans of the city for a filtration plant will be considerably modified by the accurate data on water consumption obtained. The water-works department is now upon a sound financial basis.

Hudson River Shipyard Layout To Build Concrete Car Floats

Concrete Placed for 1600-Ton Vessels From Stiff-leg Chute Tower—Will Launch Sideways From Jacked-Up Ways

BY H. W. ELDRIDGE
Engineer, Technical Department, Atlas Portland Cement Company, New York

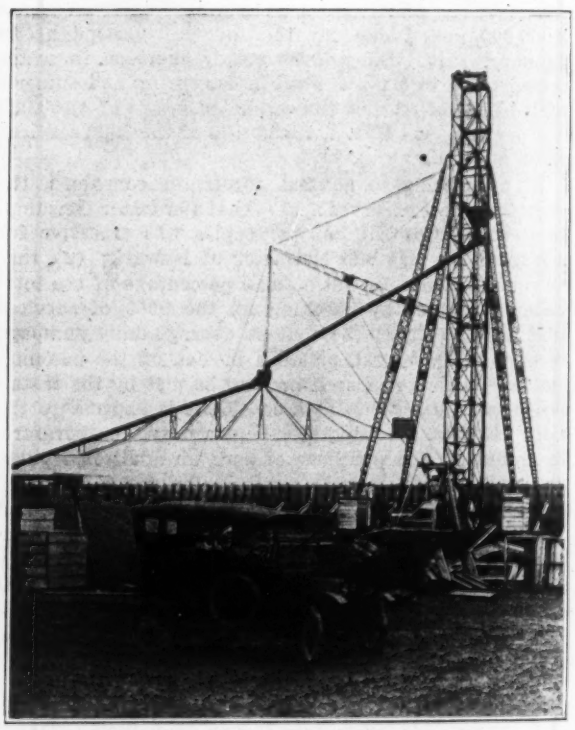
CONCRETE car floats, having a finished weight of approximately 1600 tons, which makes them the largest concrete towboats now under construction, are being built in a yard specially designed for them, at Athens, N. Y., on the Hudson River, about 120 miles above New York City. Distinctive features of the yard are the launching method and the provision for concreting from a stiffleg tower with chute which will control half of the long boat at one set-up and which can be moved on rollers to control the other half. Six of the floats are being built at this yard for the Embarkation Division of the War Department.



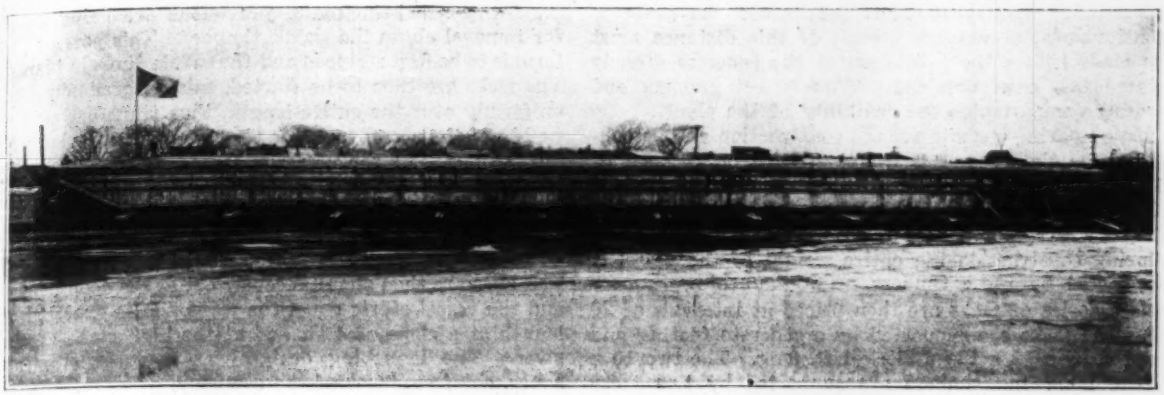
CONCRETE SHIPYARD AT ATHENS, N. Y., WHERE CAR FLOATS ARE BEING BUILT

The boats are each 265.9 ft. long, of 38 ft. 2 in. beam, and are 11 ft. 3 in. deep. They are of the general form common to wood and steel floats and provide for three lines of standard-gage railroad track with a capacity of seventeen 50-ton loaded cars. Provision is made at the yards to build two of these floats at a time on side-launching ways and to command the concreting operations from a tower running on tracks paralleling the ways. Details of the layout are shown in one of the drawings.

The river at this point has a depth of 25 ft. and a tidal range of 5 ft. The construction materials are delivered by barge to a trestle running into the yard between the car floats and the cement sheds and extending the full length of the concreting yard. This trestle supports a 24-in.-gage industrial track. The rise and fall of the tide are taken care of by a hinged joint in the trestle 30 ft. from the end. The material is loaded into 1½-yd. industrial dump cars which are hauled on



TOWER CHUTE HAS NO GUYS AND IS MOVED ON ROLLERS UNDER PLATFORM



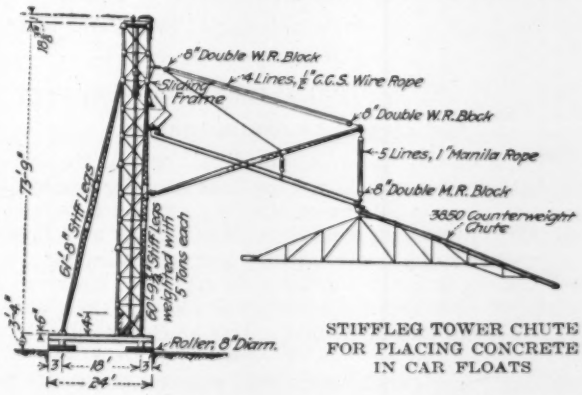
SEVENTEEN-CAR CONCRETE FLOAT ON WAYS JUST BEFORE LAUNCHING

the trestle by a line running through a snatch block to a motor truck on the ground alongside.

The remainder of the yard comprises a modern sawmill 28 x 72 ft. in plan, a steel storage yard, a steel fabricating building 20 x 24 ft., bending tables, forge and shears. A power punch is being used for the spacing angles detailed to hold the reinforcement. The remaining buildings are the garage, eating house, hardware store and small tool shack and the office building.

The concrete aggregates are graded Hudson River gravel, and are being delivered by barge from a point south of Newburgh, on the river, and the cement is delivered from Hudson, N. Y., directly opposite Athens.

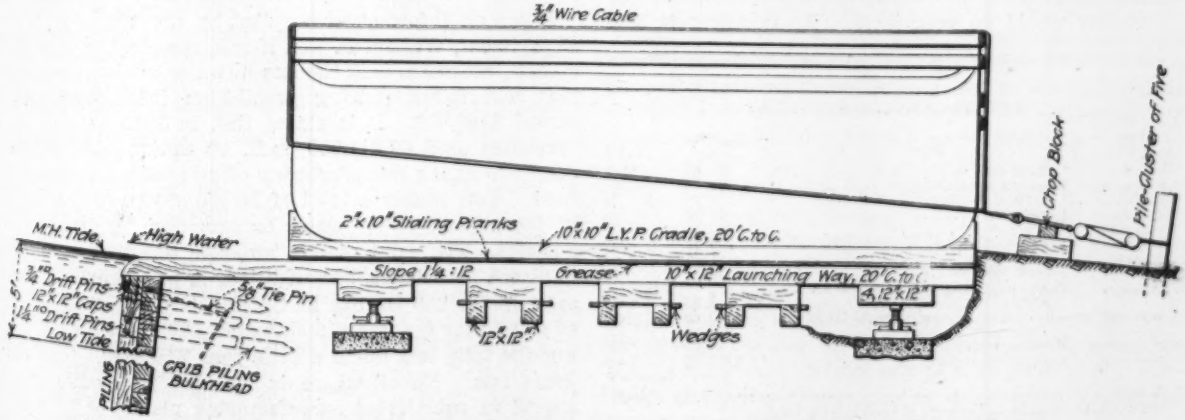
The plan for handling the concrete was worked out by the engineers of the shipbuilding company and the Insley Manufacturing Co. A steel tower 80 ft. high with a ¾-yd. mixer and chutes having a radius of 114 ft. are mounted on a specially designed platform. The tower was made portable by the use of a timber runway and 22 hardwood rollers 6 ft. long and 8 in. in diameter. The details of this steel tower are shown in one of the drawings. From one set-up of the tower it is possible to place concrete a total distance of 196 ft. It is, therefore, necessary to make only two tower set-ups for the concreting of each car float. The 50-hp. motor which furnishes power for the operation of the elevator bucket and concrete mixer is also used for moving the tower, by using a cable fastened to an anchor post or deadman. The tower and chutes are thus a complete portable unit. No guy wires are necessary, as the entire plant is perfectly balanced. There are four stifflegs fastened to the corners of the tower at a point about 10 ft. below the top, and to the tower foundation. The two on the side of the tower, opposite the chutes and boom, are weighted down each with a 5-ton sand box, which is sufficient to resist the overturning moment. The tower is very rigid, and no trouble has been experienced in maintaining the elevator bucket in true alignment.



STIFFLEG TOWER CHUTE FOR PLACING CONCRETE IN CAR FLOATS

The chutes consist of one 50-ft. boom chute and one 50-ft. counter-weight chute, and extension chutes. A complete electric lighting system has been installed.

Continuous placing of concrete is required for this work, and the tower is accomplishing this wonderfully well. The side forms for one of the floats have a total



LAUNCHING DETAILS OF CONCRETE CAR FLOAT AT HARRISON YARDS, ATHENS, N. Y.

distance of about 610 lin.ft. To place the concrete continuously, a complete circuit of this distance must be made before the initial set of the concrete already placed has been obtained. This is being done, and readily demonstrates the flexibility of the plant.

In preparing the site for the construction and launching ways the ground is evenly graded on a slope of 1¼-in. to 1 ft. Timbers made up of 12 x 12-in. logs slabbed on two sides are placed on 6-ft. centers on this grade with the top face flush with the ground level. During construction the entire weight of the vessel is supported by these timbers. Two launching timbers and a series of jacks are then placed at intervals of 20 ft. The jacks are supported by a concrete footing and capped by a 12 x 12-in. block 4 ft. long. The two 10 x 12-in. launching timbers are supported by two jacks and at the water end by the bulkhead piling, and also by 12 x 12-in. blocking and wedges between the jacks. The two 10 x 10-in. timbers which make the saddle are yellow pine. It was impossible to secure hardwood timbers, and therefore, as it was necessary to obtain a hardwood finish to the underside of the saddle timbers, two 2 x 10-in. hardwood planks are used for this purpose.

When the vessel is ready for launching a ⅞-in. steel cable is to be passed around the ends, as shown in a drawing, and anchored to a cluster of five piles. When the forms are being built, provisions are being made for removal above the saddle timbers. This part of the form is to be first stripped and the saddle timbers placed. The jacks are then to be started, raising gradually and uniformly over the entire length, thus transferring the weight of the vessel from the timber ways to the launching timbers. As the vessel is jacked the remainder of the forms are stripped and removed. The 12 x 12-in. blocking is wedged up as the jacking progressses, so that the weight is evenly distributed. This performance continues until the desired slope has been obtained. The lines are then simultaneously cut at the chop blocks, and the vessel starts down the ways. It is expected to launch at a slope of 4 ft. and at the high stage of the river. The launching design was made by William Jones, chief engineer of the company.

The contract is being executed by the Louis B. Harrison Shipyards, Inc., of 141 Broadway, New York City, under the direction and supervision of the Embarkation Division of the War Department. Mr. Jones, the chief engineer, is in responsible charge of the yard, and the War Department is represented by G. E. P. Bradley.

One vessel is ready for launching, and a second one has forms in place and steel installed and is practically ready for the placing of concrete.

Ohio Uses Cost-Plus-Lump-Sum Contract for Highway Maintenance

DURING the past year a modified form of the cost-plus-lump-sum contract has been used for resurfacing work by the Bureau of Maintenance and Repair of the Ohio State Highway Department. The new form is reported to have worked well, having encouraged the contractors to prosecute the work actively. Under the modified plan the state furnished all materials, thus relieving the contractor of the risk of rising prices.

The following example illustrates the form of procedure. The work was the reconstruction of a bituminous macadam top on an old macadam road. Selected contractors were asked to bid on the items given in the accompanying tabulation, which also gives the accepted bid prices. All labor, teams and equipment not specified in the contract were provided and paid for by the department.

In planning this contract, the objects sought were: Reduction of risk to the contractor; inducement to the contractor to push the work, and assurance that the contractor would do good work. By taking unit bids on items which are more or less uncertain, the contractor's risk is reduced. Also, since the state buys and furnishes all materials, the contractor is relieved of all risk of price advances and of delays in obtaining materials. Active prosecution of work is encouraged by the fact that the contractor's equipment and personal time are tied up until the job is finished. Finally, the contractor is assured a reasonable profit, though he has no chance of making one that is unusually large.

Maintenance work is directed in the field by patrolmen, foremen and superintendents. These men work under the supervision of a resident engineer, representing the county. The resident engineers work under the direction of division or maintenance engineers, who have charge of several counties each and who are responsible to the deputy highway commissioner.

Clinton Cowen is state highway commissioner of Ohio, and A. H. Hinkle is deputy highway commissioner in charge of the bureau of maintenance and repair.

SCHEDULE OF BIDS ON OHIO COST-PLUS-LUMP-SUM CONTRACT FOR ROAD RECONSTRUCTION

Approximate Estimated Quantity	Item	Contractor's Bid	Total
90 days	1 10-ton road roller	$6.40	$576
Lump sum	1 heavy road grader	100.00	100
Lump sum	1 contractor's plow	30.00	30
Lump sum	1 harrow	25.00	25
Lump sum	1 tank wagon	100.00	100
Lump sum	1 stone unloader	250.00	250
Lump sum	6 slip scrapers	8.00	48
Lump sum	3 wheel scrapers	30.00	90
1,000 days	Teams with dump wagon (not including driver)	4.50	4,500
Lump sum	All picks, shovels and other small tools	150.00	150
Lump sum	Moving outfit on job	200.00	200
200 days	Foremen (2)	4.00	800
Lump sum	General supervision*	1,400.00	1,400
Totals			$8,269

*Contractor must be on the work at least half the time.

Prohibition and Water Revenues at Cincinnati

Based on information supplied by the Water-Works Department, William F. Von Hoene, comptroller of Cincinnati, estimates that the loss in water-works revenues that will follow putting prohibition into effect will exceed $100,000. It is stated that in 1915 Cincinnati breweries used 65,611,000 cu.ft. of water; distilleries, 8,993,500 cu.ft.; manufacturers of accessories, 5,956,400 cu.ft. This makes a total of 80,560,900 cu.ft., said to be the normal yearly water consumption for these industries. The value of this water in terms of revenue is placed at $80,561. In addition, it is estimated that each of the 850 saloons in Cincinnati paid an average of $30 a year for water, making $25,500 and thus bringing the total loss up to a little over $100,000. This is gross loss. No allowance is included for water consumed in substituted manufacturing plants or by tenants for the quarters previously used for saloons.

Tamped Concrete Specified For Illinois Roads

Requirements Controlling Quality of Workmanship Made More Rigid—Increase in Machine Operations Encouraged

CONCRETE so dry that it must be compacted by tamping is specified for 1919 state-aid road work in Illinois. Machine tamping is encouraged, but is not required. Other new clauses tighten up the requirements for quality of construction, but they call for no radical changes in plant and methods previously employed. An outline of the new provisions which are of most significance to the contractor follows:

Consistency is rigidly defined. Broadly, it is to be "such that a conical pile of the concrete having a 45° slope will neither tend to flatten nor to run at the edges." It is to be such that the concrete will require "considerable tamping." It is required that precision of consistency be established by the following test: "A cylinder 6 in. in diameter and 12 in. in length shall be filled with concrete which shall be tamped until all voids are filled and a slight film of mortar appears on the surface. The cylinder shall then be removed and the vertical settlement or slump of the concrete noted. This settlement shall not exceed 2 in. when the mechanical finishing machine is to be used and shall not exceed 4 in. when the finishing is to be done by other methods permitted in the specifications."

Concrete is to be deposited the full depth of the slab and across the road in successive batches and then "it shall be leveled off and tamped mechanically with a machine approved by the engineers, until all voids are removed and the concrete is thoroughly compacted. The mechanical tamper shall go over each area of the pavement at least five times and at such intervals as will give the desired result." Hand tamping may be substituted for machine tamping, "providing at least four men are engaged at the exclusive work of tamping."

When machine tamping is employed the surface will be finished by two beltings, one given just after tamping and another just before initial set occurs. If hand-tamped, the slab is to be rolled once across and back and then a move forward of one-half the width of the roller, and then it is to be belted as with machine tamping. Specifications for belts and rollers and for their operation are the same as they have been previously.

Special Preparation of Subgrade

Special preparation of the subgrade is required for concrete roads. "The rolling and thorough compaction of the subgrade shall extend for a width of at least 12 in. beyond the edges of the pavement, and no backfill of any material excepting concrete will be permitted when re-rolling." In detail the accuracy of subgrade is to be determined as follows: "Immediately before any concrete is placed upon the subgrade it shall be tested for elevation by the use of a templet riding on the side forms behind the mixer. In the lower edge of the templet there shall be driven nails 6 in. apart and to such depths that their heads will just come to the true position of the subgrade when the templet is riding on the forms. Testing the elevation of the subgrade shall be done by moving the templet back and forth on the forms. On those areas of the subgrade found to be too high by as much as ½ in., additional excavation shall be made until the required depth is reached, and the excavated material shall be deposited on the shoulders. Those areas below the true elevation shall be filled with concrete making an integral part of the slab proper; all expense for this extra concrete including both labor and material shall be borne by the contractor."

Minor changes affecting equipment or construction methods are: Hauling over subgrade for greater distances than 500 ft. is prohibited. When tamping machines are used the side forms must be steel. Removal of side forms after 12 hours is permitted. Mixers shall be equipped with automatic locks or time-recording devices which will prevent emptying until the batch has been mixed for the minimum time required.

Except as noted, requirements for concrete construction remain substantially as in previous specifications. Clifford Older is chief engineer, Division of Highways, Department of Public Works and Buildings, Springfield, Ill.

New Illinois Road Specifications Work No Hardships on Contractors

By Clifford Older
Chief Highway Engineer, Division of Highways, Springfield, Ill.

ABSOLUTELY no reason exists why contractors should be alarmed over the new provisions in the specifications which have just been issued by the Division of Highways of Illinois, for concrete roads.

There will be no difficulty whatever in handling in the ordinary contractor's mixer concrete of the consistency specified, except that possibly chutes may be found unsatisfactory for distributing the material. Several of the best contractors last season placed, without any trouble, concrete of a consistency only slightly wetter than is now specified. The present mixer equipment owned by contractors will handle this concrete as economically as heretofore, except possibly in the case of mixers equipped with chutes. Except as to chutes, no mixer equipment that is in good condition and that has heretofore been acceptable will need to be scrapped.

Mechanical subgraders will not be required, nor is it anticipated that they will be needed. The new specifications for subgrading merely emphasize a little more strongly the results we have heretofore expected to secure. The only additional provision is that backfilling with loose material of any kind will not be permitted after the final rolling. This means that where depressions or ruts occur in the subgrade the high places must be cut off and the low places filled with concrete. This will work no hardship on any contractor who uses reasonable care in the preparation of the subgrade and avoids rutting or cutting it up by hauling long distances over it, after the rolling is completed.

Machine tampers are not required, although they are encouraged. Hand tamping is permitted. However, there are mechanical tampers on the market which, there is every reason to believe, will spread, tamp and finish concrete of the consistency required with less labor than has been heretofore used. The use of such a machine in St. Clair County, Illinois, resulted, without question, in a saving in cost to the contractor. At the same time, better results were secured, since the concrete could be laid without an excess of water. The machine cost about $1200, and would finish three or four times as much road in a day as the mixer could handle and only one man was needed to operate it.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Old Impact Formula Preferred

Sir—I have read very carefully your editorial of Mar. 6, p. 454, on railway-bridge impact allowances, and I beg to say that I am in thorough accord with your criticism of the proposed new impact formula. An impact formula, to be of any value, should cover other things beside impacts, especially in articulated structures where members do not always take equal stress and there are other minor defects which impair the accuracy of any calculations which can be made. These defects generally appear in the lighter members near the center of the bridge and the old impact formulas take care of these parts to a certain extent, but they are not taken care of by the new formulas. I regard the old formula as a practical one and it has demonstrated its sufficiency by long use.

The new formula, although it is the result of many tests, will not give us the results which our experience justifies us in believing more satisfactory. The new formula would make no distinction between the impacts for a single-track and a double-track bridge—or a four-track bridge, for that matter—but the old formula takes care of this in a satisfactory manner. On the whole I regard the results of the tests made by Professor Turneaure as a satisfactory check on the formula which has been used in this country for a long time, rather than something new to be introduced into our specifications.

J. E. GREINER,
Baltimore, Md. Consulting Engineer.

Compensation in Minor Engineering Positions

Sir—I dislike very much to attempt to measure verbal swords with an engineer of the eminence of John M. Goodell, but it seems to me that that gentleman, in his letter in *Engineering News-Record* of Mar. 6, 1919, p. 482, is laboring under two misapprehensions. The first is that the salaries now paid in engineering work are in any way commensurate with present wage and salary scales in other occupations, and the second, that limiting the education of men engaged in the minor engineering occupations, such as surveying and drafting, would make them satisfied with their present salaries.

As to the first, it would be obvious to everyone that the general level of wages has risen so enormously in recent years that all people on paid salaries have suffered a decrease in income none the less real because it is measured in purchasing power and not in dollars. In all occupations, where the individual is employed by others, and where the requirements of the job partake of the mental rather than of the manual, there have been no salary increases in recent years which are in any manner proportional to the great increases in the wages of manual laborers and artisans. It is from such conditions that the engineer is suffering today, and he feels it all the more keenly because he is thrown into such close contact with people of the manual-labor class.

There are undoubtedly many engineers in minor positions who are not capable of rising above their present limitations. But it does not follow that they should not, under present economic conditions, receive any increase in salary. The rise in the wages of manual laborers and artisans has not, in general, been due to any increase in their skill or to any greater value or quantity of the work produced by them. It has been due to the coercive power of organized labor in times of public stress. It is fairly easy in a manual trade to establish arbitrary scales of wages, and to insist, through the power of organization, that these scales be paid, but the man who performs his work primarily by his own individual ability, initiative and education is not so organized, and by the nature of his work cannot use the coercive power of organization to increase his salary. Such increases as he gets are usually due to an actual increase in the value of the work done by him, and have but slight reference to changes in the cost of living.

As to the second misapprehension, I know of no surer way to increase the wages of transitmen and draftsmen than to limit their education to that which might be obtained in a mere trade school. For, if the transitman or draftsman were possessed only of such education and ability that he had no opportunity or aspiration of attaining to a higher engineering position, it is certain that he would, in due course, become a labor union man, and use the power of union labor to secure a greatly increased wage for himself. Surely the transitman's or draftsman's manual skill is at least as great as that of the carpenter or the bricklayer, and the work which he accomplishes is at least of as great a value. Why should he not, therefore, receive as high a wage? The main reason why he does not is because he feels that he has a certain amount of ability and education which may in the future enable him to rise to a position requiring real engineering knowledge, and it is that hope and expectation that lead him to reject the simpler and surer method of wage increase through organization, coercion and strikes.

The "under dog" in engineering today is not, as Mr. Goodell asserts, kicking at his salary because he thinks that he should receive more money simply because he has an expensive education. He is kicking because other men, who have no special education, and are doing work requiring no greater manual skill and not so much mental ability as his own work calls for, can now afford to sport limousines on their recently greatly increased wages, while the purchasing power of his own salary has become less and less. He knows that the value of his services has not decreased, and that the value of the artisan's services has not increased. He knows that if his services were worth more than the skilled laborer's ten years ago they are still worth just as much more. He knows that something is wrong, and that he is made to suffer, through no fault of his own, in the general readjustment of economic conditions. Therefore, when he goes to his employer and as one man to another, without threat or intimidation, asks for a raise in salary, the employer should be the first to recognize these conditions. Yet, because this same employer is himself suffering from economic conditions, and perhaps has been forced to pay higher wages to his manually skilled employees, he often adopts the

"penny wise and pound foolish" policy of refusing the request because he is not forced to grant it.

It might be expected that where the employer is himself an engineer he would be the more ready to recognize the value of the services of his subordinate engineers. Yet how many of your readers are familiar with that type of employing engineer, perhaps a member of the Am. Soc. C. E., who, when approached by a subordinate for a raise, regales him with stories of how, when he was young, he worked for $50 or $60 a month on difficult and responsible work, and believes that all engineers should go through the same mill. To the suggestion that $50 or $60 a month in those days was as good as $100 a month today he turns a deaf ear.

There are, however, some employing engineers who are beginning to see the light, and who realize that the profession can never be maintained upon a high plane by the practice of paying lower wages to subordinate engineers than to mechanics, and some of the more enlightened of these men have associated themselves with other engineers, some of them representatives of the "under dogs," in an earnest endeavor to raise the whole scale of engineering salaries to a plane more nearly representative of present economic conditions. I refer to the American Association of Engineers, which is the only national organization of engineers that concerns itself with the bettering of the economic condition of the technical engineer, and seeks to do this through methods compatible with the dignity of a useful and learned profession. I hope that ere long all engineers will see the light. If not, the future of the profession is dark indeed.

Washington, D. C. KENNETH P. ARMSTRONG.

Boston Engineers' Trade Union Dinner

Sir—What is perhaps a significant sign of the times is furnished by a dinner of Boston engineers, held at the City Club on Mar. 25. The dinner was given by the Civil Engineers' Association of Boston and was its third annual banquet. This organization is made up of men working for the City of Boston and the State of Massachusetts, and is affiliated with the American Federation of Labor. Also present at the dinner were the members of the Civil Engineers' and Inspectors' Union No. 16,347, which is likewise affiliated with the American Federation of Labor, but is made up of men working for private employers. A number of men engaged in private engineering practice were among the guests. One of the after-dinner speakers was Maj. Gen. Clarence R. Edwards, who described the work of the Army engineers of the 26th Division.

The keynote of a number of the other speeches was advocacy of the organization of professional as well as trade workers to protect the rights of the individual. The president of the association said that while some members had resigned as a result of the association becoming affiliated with the American Federation of Labor, a much larger number had been induced through this move to join the association.

The dinner was certainly an enthusiastic one, and showed that those present looked forward with confidence to an increase in their salaries as a result of their alliance with the American Federation of Labor. It appeared that benefit to engineers had already been gained by the support of the federation before the State Civil Service Commission. It seemed to be the general opinion of those present that no question of professional ethics is involved by affiliation with organized labor and that this is not in conflict with the objects of the professional engineering societies. These societies, it was held, had concerned themselves essentially with the scientific and intellectual needs of the profession rather than with the business welfare of their members. Some speakers pointed out that legal and medical associations do not hesitate to take action to protect the business interests of their members.

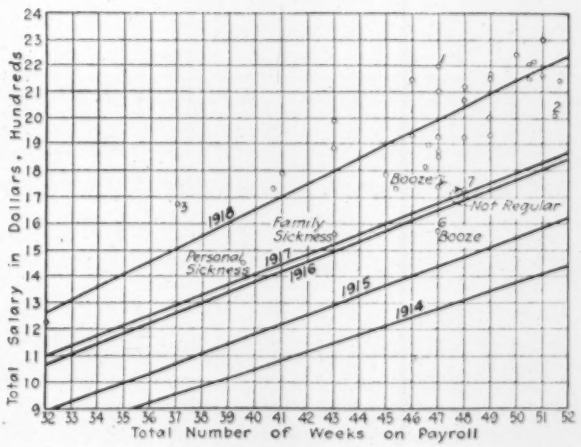
Whatever opinions one may hold for or against the trade-unionizing of the engineering profession, it is well for all of us to face fairly and understandingly the conditions that confront us today. This public dinner and the prevalent sentiment which it voiced seems to reveal a condition more widespread than many engineers realize. OBSERVER.

Boston, Mass.

What Carpenters Earn with One Contractor

Sir—With the present agitation for higher wages in the building trades, due to increased cost of living, a study of actual earnings by carpenters in the New England district during the year 1918 gives interesting results.

In a recent War Labor Board hearing in New York City Dr. William F. Ogburn, statistician for the board, stated that "budgets arrived at scientifically, based on the actual expenditures of over 600 families, consisting of five members, father, mother and three children, two of whom were of school age" would amount, at the present time, to $1500 for the "bare sustenance level," $1800 for the "minimum comfort level" and approximately $2100 for the "security and citizenship level." He further stated that in his opinion the smallest in-



CURVES SHOW ACTUAL EARNINGS OF CARPENTERS EMPLOYED BY ONE LARGE CORPORATION

Average curves for each year are based on actual earnings of a number of men for that year, the small circles showing earnings in year 1918. Wages were as follows:

1914, 50c. per hour to June 1; 55c. per hour remainder of year; 10-hour day, straight time for overtime.
1915, 55c. per hour whole year; 10-hour day, straight time for over time.
1916, 55c. per hour to June 1; 60c. per hour remainder of year; 10-hour day, straight time for overtime.
1917, 60c. per hour to June 1; 65c. per hour remainder of year; 10-hour day, straight time for overtime to Sept. 13, then 8-hour day, 1½ time or double time for overtime.
1918, 65c. per hour to June 1; 70c. to Sept. 1, 75c. remainder of year; 8-hour day; 1½ time or double time for overtime.

come on which such a family with present living costs could live and enjoy health and comfort was $1800.

The attached chart shows the average earnings for a group of approximately forty carpenters employed by our company over a period of five years. For example, a carpenter working at the rates and hours noted, if on the payroll for 52 weeks or the entire year, should have earned the following amounts: In 1914, $1440; 1915, $1620; 1916, $1845; 1917, $1870; 1918, $2240.

How did the men whose actual 1918 earnings are represented by the circles fare during that year? Our employment records show that for this group of men the average family included mother, father and one and one-half children. Using the minimum comfort budget of $1800 as a basis, and allowing $250 per child, the budget for this family calls for $1375 per year. The father, however, on an average had to spend about six months of the year away from home to get work. This would add, over normal expenses, approximately $10 per week, or $260 for the six months. The family budget then becomes $1635 for the year. Referring to the chart, we see our "average-family" carpenter would have received that amount in 39.5 weeks. We also see that every man in the group with the exception of three received well over this amount.

Why did some of the men earn so much more than others?

Referring to the chart again, specific cases are interesting.

No. 1. A very steady man; quit his out-of-town job the minute overtime was cut out. Had he worked five weeks longer, and rounded out the year, he would have received $2360 for his year's work.

No. 2. The star worker of the group. For the years 1914-1917, inclusive, his earnings ranged from $50 to $150 above the average. During 1918 he did not care to work Sundays and took a day off now and then. He was satisfied and reported to the writer he had saved "about $500." His family consists of himself and wife.

No. 3. A widower with four children. He is an "overtime chaser"; "works for any company having overtime work." He left at the end of the thirty-seventh week and went to a shipyard building wooden ships. His reported earnings for the remaining portion of the year would indicate that he received at least $2500 for his year's work.

Nos. 4 and 5. Owing to personal and family sickness these men cannot leave Boston and must therefore take what work comes along in that city.

Nos. 6 and 7. One of our foremen reported that two of his men were going "to the dogs." One "boozed," the other had a habit of leaving on Friday night and showing up for work Tuesday morning. The wage record seems to prove that the foreman is correct.

Earnings for 1919 will probably not approach those of 1918 by a considerable amount. The building trades at the present time are flat, thus causing considerable unemployment. Prospective builders are waiting for a drop in material and labor prices. Owners who have started building insist there shall be no overtime; the "straight" eight-hour day and not the "basic" eight-hour day shall prevail. Labor leaders demand a 44-hour week (in Boston the 40-hour week is already in effect in a few of the trades); they insist there shall be no reduction in rates; in fact, owing to the constantly increased cost of living (?), there seems to be a universal demand for greatly increased hourly rates.

The wage situation in the building trades certainly warrants a close study. Unless all parties concerned "lay their cards on the table, face up," and *coöperate*, the coming summer will have a deluge of squabbles, with consequent strikes.

O. R. RIETSCHLIN,
Employment Manager, Aberthaw Construction Company.
Boston, Mass.

The Pioneer National Society to Adopt the Cleveland Plan

Sir—May I call the attention of your readers to an oversight that occurred in *Engineering News-Record* of Mar. 6, 1919, pp. 454 and 495? The first national society to adopt the Cleveland plan of joint membership was not the American Society of Mechanical Engineers, in 1919, but the American Association of Engineers, in 1918.

Joint membership is not a panacea; it is but one step toward closer relations among all engineers. The next step might by the adoption of this plan, as modified by experience, by all the national societies in unison and in addition requiring, as recommended by the Intersociety Relations Committee of the Cleveland Engineering Society, and as approved by the American Association of Engineers and the Association of Ohio Technical Societies, that applicants for membership in national societies shall show as a prerequsite for membership that they are members of an accredited local society.

C. E. DRAYER,
Secretary, American Association of Engineers.
Chicago.

Why Not Engineers for Federal Rural Health-Protective Work?

Sir—I have noted the comments of H. C. Hodgkins, in *Engineering News-Record*, Mar. 13, p. 535, on the above-named subject. Having been employed by the United States Public Health Service, I am familiar with its attitude toward the sanitary engineers employed on public-health work, such as drainage for "mosquito eradication." I can say from experience that such engineers have been allowed very little responsibility. While this may be due to the nature of the work given them and to the reputed lack of executive ability among engineers, there is no question that the medical officers in charge are jealous of their position and authority and prone to consider as an instrusion the exercise of authority by any nonmedical officer.

The opinion has been widely held that only medical men are fitted to supervise matters of public health. This fallacy has long ago been dispelled, for there is a large and growing number of nonmedical, though specially trained, health officers who are making their influence felt, to the discomfiture perhaps of the medical profession. My attitude has always been that the sanitary engineer is the proper person to direct public-health work as the problems are primarily engineering problems and the medical phases are, largely, purely incidental. This view is gradually gaining ground, I believe. Efforts have been made in the Public Health Service to obtain for the sanitary engineers wider

responsibility and higher standing, but all efforts have been vetoed, due to the predominance of medical men in the service. As a result, the medical officers have been giving more time to engineering problems, such as labor questions, pay rolls, and field drainage details, than to the duties for which they are fitted. In my own experience, I found that the medical officer in charge of my station was more interested in the wages paid my laborers than in the health of the laborers themselves, for while he was interfering with the field work one of the workmen was ill for three weeks with spinal meningitis, a communicable disease. In another case, the medical officer spent a large part of his valuable time in writing out checks to cover a large payroll for labor on work which was under the supervision of the sanitary engineer.

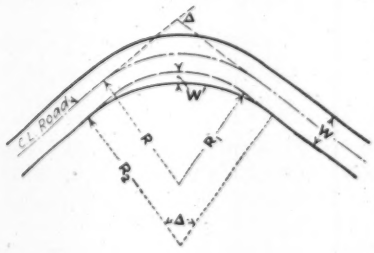
The sanitary engineer has charge generally of important phases of sanitation and general public-health work, and he should have responsibility in keeping with the nature of the work performed. Engineers must take the stand that they are as important factors in respect to the public welfare as doctors of medicine—they surely are as high-grade men, on the average.

E. G. SHEIBLEY,
Hydraulic and Sanitary Engineer.

Riverside, Calif.

To Compute Added Area on Highway Curves

Sir—The following simplified formula for computing the extra area in pavement due to widening at curves may be of some interest to highway engineers. In all cases which I have met, slide-rule computation is accurate to tenths of a square yard, and may be used to save time.



With the notation shown on the diagram, it can be shown:

$$R_1 = R - W/2$$

$$R_2 = R_1 + \frac{W'}{exsec\ \Delta/2}$$

Area added $= (R_2^2 - R_1^2)$ $(tan\ \Delta/2 - \Delta/2\ radians)$

W. W. CRAWFORD,
Division No. 1, Wisconsin Highway Commission.

Madison, Wis.

The Duluth Way of Meeting Cost of Water-Main Extensions

Sir—The two editorial notes in your issue of Mar. 20, "Meeting the Cost of Water-Main Extensions" and "Assessment of Benefits Deserves More Attention," lead me to send you a copy of a paper on the general subject that I wrote a few years ago (see *Jour.* Am. W. W. Assoc., December, 1915, p. 612).

The criticisms in your articles are to the point and are vital. Since the adoption of our method of making extensions in Duluth there has been but little criticism, with no attempts to change the system. If the extension is designed to boom real estate the plan throws the burden upon the property. If bona-fide consumers exist or build along the line of the extension afterward, the property is gradually relieved, so that eventually the consumers pay for the entire expense of the service.

Under this method no vacant property escapes where contributions are necessary in order to evade a losing proposition so far as the Water Department is concerned.

D. A. REED,
Manager Water and Light Department.

Duluth, Minn.

[Under the Duluth plan, 8% of the first cost of a 6-in. water main is charged annually against abutting property, for 15 years, on the basis of 5% interest and 3% sinking fund, or the charge may be paid in one installment, at 25% discount. Against this charge is credited one-half of the water revenue paid by the occupant of any premises. The other half is allowed for operating expense. Vacant property bears the entire 8%. The charge is based on frontage, with no debit for the second side of a corner lot. The same plan is followed for gas (the city owning the gas works) except that a 4-in. main is the base and only one-third the gas rates paid are credited against the charge.

Strictly speaking, this is not an assessment for benefit, but rather a uniform and, so far as appears, an arbitrary annual charge in lieu of rates for 15 years, with a penalty for letting property remain vacant. It is virtually a guarantee of 8% on the cost of a minimum-sized main, but the guarantee terminates in 15 years, regardless of how few water consumers there may be on the street. It is much fairer than the apparently common practice of letting one or a few willing persons bear the entire guarantee of revenue, or even put up the entire first cost of an extension, with no means of compelling other property owners to do more than pay ordinary water rents when they become consumers.—EDITOR.]

Colorado River Flood Control by Storage Promising

Sir—Mr. LaRue's article in *Engineering News-Record* of Mar. 6, 1919, p. 456, on the control of the Colorado River by storage offers a promising solution to a situation growing more precarious every year.

Here is a river which menaces the most intensively productive region in the world, the Imperial Valley. Head-water storage on the Colorado will have its full effect in flood prevention in this valley, a thousand miles below the source of floods and the reservoirs proposed to prevent them. This situation, then, is unique, in problems of flood control by storage, in that herein is contained every promise of ultimate success. Examine the figures given for the 1917 flood and imagine what would have happened if the Grand River peak had been delayed a week. The Yuma peak instead of 143,000 sec.-ft. might have reached 165,000, and the levees might have been overtopped at all points.

Immunity from flood damage in the lower Colorado hangs by too slender a thread not to begin at once a comprehensive study of the possibilities of permanently removing this menace by storage. The data which Mr. LaRue points out as necessary cost an altogether insignificant sum, considering the important purposes they will serve. The study should be begun without further delay.

J. C. STEVENS.

Portland, Ore.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Trailer Shield Holds Sides of Caving Ditches in Pipe Laying

BY MEANS of a cage or shield pulled by the trench excavator and protecting the pipe-laying operations, drain pipe for a large system of tile drains was successfully laid without sheeting the badly caving ditches. Ordinary methods of handling caving ditches permitted a daily progress of only 50 ft. With the shield, a progress of 425 ft. per day was made under the worst conditions of spring work, and later in the season, when water was less troublesome, the daily progress was from 700 ft. to 1500 ft. of pipe laid. Two men working inside the shield laid the tile.

The work was located near Garden Prairie, Ill., where soil conditions were very difficult. The top soil was a black gumbo about 3 ft. deep. Below the gumbo were 4 ft. of joint clay, very rotten and crumbly in texture, and below the joint clay there was from 1 to 4 ft. of fine sand and water. The sand was so fine that it was carried by the water from under the trench sides, causing them to cave in, until the trench was often 40 ft. wide at the top.

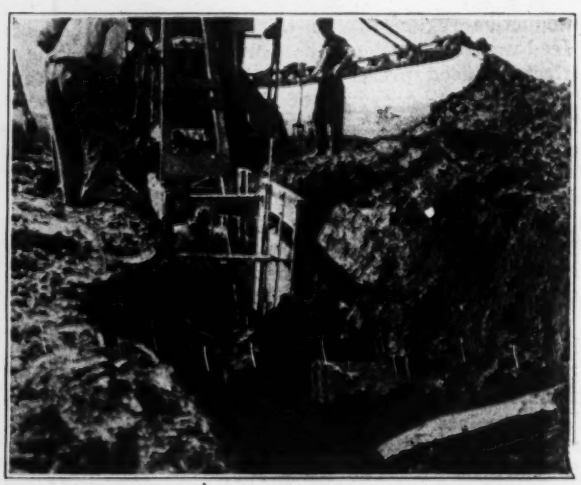
Tight sheeting was first used by the contractor and it was fairly successful in holding the banks, but its cost was prohibitive at the price for which the contract was taken. Sand boxes and various other methods commonly employed for controlling sand and water were tried, without success. Finally the contractor adopted the method of spading the sides of the ditch down into the excavator buckets until no more dirt would fall in. This method was very slow, the average daily progress being 50 ft. per day. The contractor was unable financially to continue the work and it was recontracted.

Construction was resumed in the spring with an outfit consisting of a trench excavator, a power backfiller, a large power-driven diaphragm pump and a trench shield devised by the new contractor. At the beginning of the work the soil conditions could hardly have been worse; the spring rains had soaked the earth and the water level was the top of the ground. The shield met these conditions successfully. The accompanying view shows it in operation.

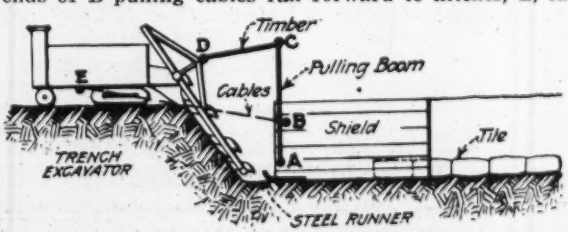
The success of the shield in operation was due wholly to the pulling method employed. Structurally the shield consisted of two side panels held apart by screw braces and held together against the braces by horizontal and diagonal turnbuckle ties. Between the sides, at the front end, stood a vertical mast or pulling boom. From the pin, C, at the boom top two timbers extended forward to the boom, D, of the trench excavator. The bottom of the pulling boom was set on a pulling bar, A, whose ends set into the side panels and which extended across the shield. The bar, A, could be raised or lowered, but ordinarily such a change was not necessary. At B another pulling bar extended across the shield, and its ends passed through the side panels. From the ends of B pulling cables ran forward to hitches, E, on the trench excavator. The bar, B, could be quickly shifted up and down with respect to the height of the shield and, being behind the boom, AC, it pulled against the boom. This method of hitching the shield to the excavator involves a care in adjustment which is not indicated in the diagram and upon attention to which, the contractor states, much of the success of operation depends. The shield weighed about 1500 pounds.

Other Articles in This Issue of Interest to Contractors:

Constructs Largest Gas Line in the United States — Page 706
Malaria Control at Nitrate Plant — Page 718
Planning Work Expedites Casing of Pipe Line With Concrete — Page 725
Piecework Faster Than Day Labor on Hand Excavation — Page 727
Ohio Uses Cost-Plus-Lump-Sum Contract for Highway Maintenance — Page 734
New Illinois Road Specifications Work No Hardship on Contractors — Page 735
What Carpenters Earn With One Contractor (Letter) — Page 737



SHIELD PROTECTS PIPE LAYING OPERATIONS IN CAVING DITCH



METHOD OF HITCHING SHIELD TO TRENCH EXCAVATOR

In the operation of the shield, two men worked between the sides of the shield with short-handled shovels, one man working in the front end cleaning up the bottom of the trench and aiding the second man, or the pipe layer, in making a perfect grade. This combination gave excellent results, and only very seldom was the machine stopped to wait for the pipe men, who were able to lay two tiles within the sides of the shield at one time.

The most serious obstacle encountered by the contractor was water. Heavy rains fell every few days, and the water at all times was so high in the pipe that had been laid that the pump was constantly used to keep the trench dry; nevertheless, the work went forward with a daily average of 425 lin.ft. Later in the year, after the rainy season was over and the pump was no longer needed, daily runs of 700 to 1500 ft. of pipe laid were frequently made.

The adaptability of the shield to any width or depth of trench was one of the main features. To change the width of the shield the screw jacks were run in or out, and the width of the shield was changed accordingly. At the time when the length of the screw jacks was altered, it was necessary to alter the turnbuckles. To alter the height of the shield to fit a trench of greater depth, it was necessary to add horizontal members. There were limits, however, to the practical depths and widths at which this device could be operated. The shallower the ditch, the easier it was to operate the shield. However, it could be operated with success down to depths of 10 ft. and out to widths necessary to fit a 60-in. trench.

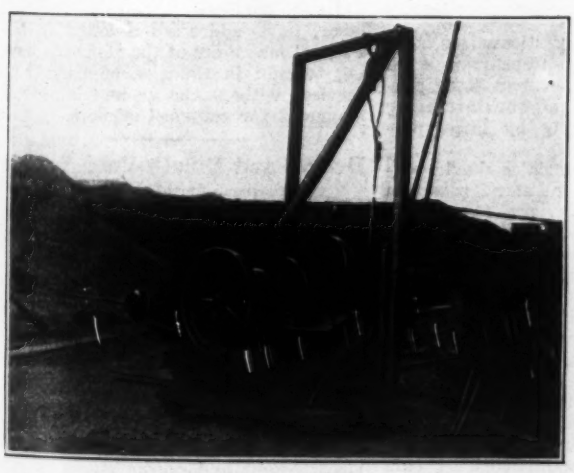
The contractor for the work was Monroe Farrer, of 4045 W. Van Buren St., Chicago, Ill., who designed the shield and perfected its operation.

Portable Home-Made Gasoline Drill

By C. M. Young

Engineering Experiment Station, University of Illinois, Urbana, Ill.

THE accompanying illustration shows a portable outfit consisting of an auger drill, driven by a gasoline engine, which has been successfully used in boring vertical holes through soft surface ground and soft shale. It was developed by a subcontractor for boring holes in blasting the excavation for a building. The shale to be drilled is 3½ ft. thick, not hard but somewhat gritty. While the apparatus was intended for vertical holes, there is no reason why the drill should not be turned in any direction.



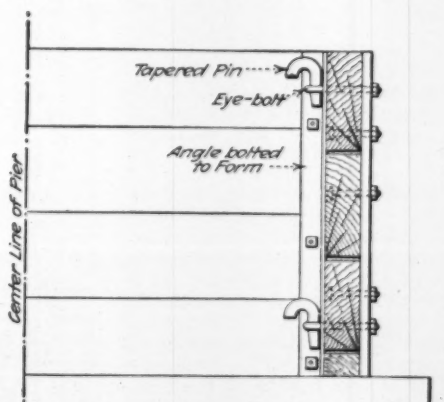
AUGER DRILL DRIVEN BY GASOLINE ENGINE BORING VERTICAL HOLES THROUGH SOFT SHALE

The outfit consists of the ordinary bit and chuck used in coal mining, a gasoline engine, and suitable belting and reducing gears. The engine is of 4 hp. and is belted to a shaft which carries the beveled gear for driving the drill. The speed of the drill is about 150 revolutions per minute.

The drill is fed downward by a rope fastened at one end, passing over a sheave wheel at the top of the drill rod and down to a hand winch. It is raised by a rope hooked to the end of the rod and passing over a pulley at the top of the frame. A 2-in. bit is used, and the machine is drilling 100 holes per day through the 3½ ft. of shale. The average time for drilling one hole, including one change of bit but not the moving of the machine, is 3¼ min. In surface soil of average hardness the drill has been put down 2½ ft. in 5 sec. The whole outfit is mounted on a frame carried on three rollers and is pulled from hole to hole by hand. Only one man is needed to run it and move it. The gasoline consumption is one gallon for eight hours of steady work.

Device Simplifies Footing Form Removal

THE arrangement shown in the accompanying picture is in successful use by William G. Cooper, contractor, on his footings for the Gravesend Ave. elevated line in Brooklyn. These forms are used many times over, and the simplicity with which they may be assembled and stripped adds greatly to their life. To each end of the two cross-forms is bolted an angle which has been punched to allow an eye-bolt to pass through it at two or more places. These eye-bolts are a part of the longitudinal forms, and are spaced to match the holes in the angles. The two forms are held together by tapered pins with hooks at the top. Hammering on the top of the bend drives them snugly into place during assembly, while a few taps on the lower end of the hook loosens them as easily. Edward Murphy is superintendent and Charles Mannel is engineer for the contractor.



SIMPLE HOOKED PINS FOR PIER FORMS MAKE FOR RAPID REMOVAL

NEWS OF THE WEEK

New York, April 10, 1919

Railroad Wage Board Gives Engineers Hearing

Three Days Devoted to Pleas That Technical Engineers on Railroads Be Given Uniform and Higher Pay

Much sooner than expected, the Railroad Board of Wages and Working Conditions, on Mar. 31, Apr. 1 and 2 gave the technical engineers a hearing and a chance to present the schedule adopted at the National Conference of Railroad Engineers held Mar. 17 in Chicago, under the auspices of the American Association of Engineers.

Marshall O. Leighton, chairman of the National Service Committee of the Engineering Council, arranged for the meeting and the board sent an invitation to the American Association of Engineers to appear at the same time, an arrangement which suited both organizations. After Mr. Leighton opened the meeting Francis Lee Stuart, consulting engineer, New York, representing the Engineering Council, pointed out the need and justice of increasing salaries. While in sympathy, he was not in touch with the details, and turned the question for proofs over to the American Association of Engineers. C. E. Drayer, secretary of the latter organization, presented documentary evidence of the representative character of the railroad conference in Chicago, which he held represented the 40,000 engineers in subordinate positions, and submitted the following memorandum:

"We urge the classification and standardization of conditions and salaries for railroad professional engineers in the classes under consideration. Two illustrations are mentioned for the purpose of making plain the need. From questionnaires recently sent out, the American Association of Engineers finds that three roads are paying instrumentmen $105 a month, while several other instrumentmen on the Pennsylvania R.R. are doing resident engineers' work, consisting of the construction of an engine terminal, and are receiving instrumentmen's pay.

"The benefits to be derived from classification and standardization are: (1) Elimination of the discrimination that exists between engineers in railroad service; (2) it will permit readjustment of salaries and working conditions on a definite and sound basis.

"It is admitted by all that there should be certain definite relations in pay among men who are doing the same kind of work; that there should be certain standards whereby a man who is qualified to perform a certain kind of work, and does it, should receive a certain pay. We find on the different roads, from 1200 questionnaires sent out and received last week from some 60 different roads, that men doing precisely the same kind of work are being paid salaries differing by large percentages.

"The following principles should govern in classification and standardization of positions and salaries: (1) Standard and distinctive details of all positions having similar conditions and working requirements; (2) definitions of duties and responsibilities of each position; (3) definitions of classifications and requirements of each position; (4) placing of positions into classification according to the character of duties and according to responsibility and division of work; (5) positions of the same kind, made distinctive according to duties and responsibilities, should carry the same rate of pay."

(*Concluded on page* 745)

Employment

For the convenience of engineers returning from military life, and others, there are listed below agencies which may be helpful to those who are seeking employment:

Engineering Societies Employment Bureau; secretary, 29 West 39th St., New York City.

American Association of Engineers, 29 So. La Salle St., Chicago. Service to members only, but Army or Navy engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, maintained by the Joint Council of Engineering Societies of San Francisco, Engineers' Club, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

The Federal director of the United States Employment Service in New York State announces the receipt of a letter from J. P. Morgan & Co., in which $100,000 is offered for the purpose of continuing the work of the service up to July 1 of this year. The Professional and Special Section in New York will therefore be continued, but will be located at the main office, 469 Fifth Ave., New York City.

St. Louis $23,000,000 Bond Issue

A commission appointed by the mayor of St. Louis has listed the items which it considers should be covered by the proposed bond issue of $23,384,000, this being the amount the city can issue without exceeding its bonding limit. The tentative list is as follows: River des Pères channel, $10,495,000; sewers, $3,420,000; parks and playgrounds, $2,850,000; grade crossings and viaducts (city's share), $1,034,000; extension of municipal dock, $1,000,000; municipal belt railway, $1,000,000; connection between the municipal railway and tracks on the municipal bridge over the Mississippi, $1,000,000; municipal auditorium, $1,000,000; street openings and widenings (city's share), $750,000; municipal farm, $400,000; fire houses and equipment, $200,000; industrial farm, $150,000; jail extension, $85,000.

New Jersey Passes Tunnel and Bridge Bills

Bills authorizing the construction of a vehicle tunnel under the Hudson River at New York, and a street bridge over the Delaware River at Philadelphia, have been passed by the New Jersey legislature and are before Governor Edge for approval. Preparations have already been made to provide an appropriation of $1,000,000 as New Jersey's initial contribution to the Hudson River tunnel. Until 1922 money for this work will have to come from the state's surplus fund, but in 1922 a direct tax can be levied, under a new constitutional provision.

Free Service to Soldiers

A number of employment agents in Chicago, handling principally railroad labor, have addressed a letter to the Federal managers of the railroads having termini in Chicago, offering their services without charge in finding employment for returned soldiers.

Detroit and Duluth Vote Against Buying Street Railways

Municipal purchase of street railways was voted down at both Detroit and Duluth Apr. 7, the popular vote being 63,382 against and 59,479 for at Detroit and 8886 against and 4902 for at Duluth. The proposed purchase price of the United Railway lines at Detroit was $31,500,000.

Votes for Municipal Ownership

Municipal purchase of the water, gas electric-light and power plants of Superior, Wis., was indorsed by a large majority popular vote Apr. 7.

War Department Has Locomotives and Cranes For Sale

Announcement has just been made that $45,000,000 worth of locomotives and cranes is for sale by the Director and cranes are for sale by the Director General of Military Railways, whose office is at 6th and B Sts., N. W., Washington, D. C.

The equipment to be sold is material which was built for shipment overseas, and for the most part is in crates at Atlantic seaboard ports of this country. It includes 22 locomotive cranes of capacities from 10 to 50 tons, 34 raised pier locomotive cranes of capacities of 10 and 15 tons, 20 railway track piledrivers, 6 two-boom cast gantry cranes, 212 standard-gage Baldwin locomotives, and three 36-in. gage dinkey locomotives, a great number of cars of the box, gondola and dump-car types, hoisting engines, railway rails, generator sets, steel searchlight equipment and automobile trailers.

The cranes, as stated, are all packed for export and are available for immediate shipment. The cabs of the cranes are built with French clearances for bridges and tunnels, considerably lower than those in this country. The cranes, however, are standard in their engine and working parts.

New York Port Treaty Postponed

After a number of hearings on the desirability of the immediate adoption of the interstate treaty governing the joint control of the port of New York, it has been decided that the proposed treaty will not be submitted to the two legislatures at the current session. This decision was reached by the interstate commission after it became evident that the city government of New York is opposed to the port treaty as it now stands.

Both states have promised funds to continue the commission's studies, and it is reported that a definite, comprehensive plan for port development will be submitted next year. This is in accordance with the vote of the Board of Estimate of New York City to withhold approval of the treaty until after such a comprehensive plan had been prepared.

Large Hydraulic Turbines Ordered

Orders have been placed with the Westinghouse Co. for two 45,000-kva. vertical water-wheel generators of 12,000 volts, three-phase, 25 cycles, for the Queenston development of the Hydro-Electric Power Commission of Canada. These will be the largest hydraulic turbines yet built.

Cleveland Clearwater Basin Case Hearings Concluded

Testimony before the master appointed by the court in the suit of the City of Cleveland against the Walsh Construction Co., on account of the reconstruction of the clearwater basin at the West Side filtration plant, has been concluded. The issues involved are a claim of the contractor against the city for unpaid balance, and a claim of the city against the contractor for damages on account of the necessity for reconstructing the basin by jacketing it with reinforced concrete. Robert Hoffmann, city engineer, was appointed master by the court to take testimony and report on the facts involved; it is likely that his report will be rendered soon.

Conflict Over Bids on Cost-Plus Contract for Viaduct

Bids received by Kansas City, Mo., for the construction of the 23rd St. viaduct on plans and specifications providing for a profit-sharing form of cost-plus bidding have led to a political conflict which is delaying the award of a contract. The Board of Public Works declared the A. S. Hecker Co. of Cleveland the lowest and best bidder, but the City Council refused to confirm the award of the contract. A local bidder was only a fraction of 1% higher. Ostensibly the opposition of the council majority is directed against the cost-plus form of bidding; it is claimed that the city is not adequately protected against excessive cost. Engineers familiar with the situation say, however, that the political organization opposes the award of the contract to an outside contractor.

Under the contract as drawn by Harrington, Howard & Ash, consulting engineers for the city on the viaduct, the bidders fixed an estimate of cost plus contractor's fee; if the cost exceeds the bid estimate the contractor will have to pay half the excess, but in all events he receives a minimum fee of $15,000, his bid fee, while if the cost is below his estimate the city and the contractor divide equally. The Hecker bid on this basis was $716,000, including a fee of $50,000.

Strong sentiment has developed in the city over the refusal of the council to approve the award of the contract. The Kansas City Engineers' Club on Mar. 31 held an open discussion on the subject of the viaduct contract in which a representative of the local bidder whose bid was next above that of the Hecker Co. received opportunity to present his side of the case. As a result of the hearing, the club passed resolutions affirming the imperative need of building the viaduct at the earliest possible moment, demanding that the city have open competition on all municipal construction work and accord outside bidders the same treatment as local bidders, and approving the profit-sharing cost-plus form of contract as used for the 23rd St. viaduct.

This is a radical departure from the principle which the club has followed in the past of not concerning itself with civic affairs, although in technical matters the club has been progressive and active. Local engineers have expressed great satisfaction with the club's action and believe that it will develop the organization into a more forceful one, and one of greater influence on public questions.

Allegheny Bridges Ordered Raised by Secretary Baker

In spite of strong opposition from the Pittsburgh council and from citizens of the city, Secretary of War Baker signed Mar. 31 an order requiring that the bridges over the Allegheny River at Pittsburgh be raised immediately. Work upon these raising operations was suspended during the war, and is now to be resumed upon the same terms as previously ordered. The county will have the same time limits as originally prescribed.

This action was taken as the result of a recommendation by the Rivers and Harbors Committee of the Pittsburgh Chamber of Commerce—although opposed by the Municipal Affairs Committee of the chamber—the final vote of the chamber as a whole resulting in favor of the adoption of the Rivers and Harbors Committee request. The original order was dated Mar. 23, 1917, at which time eight bridges were to be raised. Of these, one has burned down, the Pennsylvania R.R. bridge has been raised, and the owner of another is raising and rebuilding it voluntarily. The order, therefore, requires the county commissioners to proceed with the raising of five bridges immediately.

Pennsylvania Gets Early Start On Road Bond Issue Construction

In order to get an early start on construction under the new bond issue, the Pennsylvania State Highway Department, of which W. D. Uhler is chief engineer, has announced the appointment of the 15 engineers who will be in charge of the various districts into which the state is divided. A number of changes have been made in the personnel of the various districts. The engineer in charge, the district number, and headquarters are as follows:

District No.	1.	D. C. Stackpole, Bellefonte.
"	2.	C. W. Hardt, Harrisburg.
"	3.	A. S. Clay, Bloomsburg.
"	4.	H. W. Claybaugh, Franklin.
"	5.	W. R. Wolfinger, Allentown.
"	6.	C. W. Erismah, York.
"	7.	W. F. Cressman, Philadelphia.
"	8.	W. O. Bennett, Du Bois.
"	9.	W. S. Hammacher, Chambersburg.
"	10.	J. S. Ritchey, Wellsboro.
"	11.	C. S. Lemon, Hollidaysburg.
"	12.	W. H. Bircher, Scranton.
"	13.	C. E. Myers, Pittsburgh.
"	14.	W. D. Myers, Washington.
"	15.	F. E. Winter, Warren.

Would Improve State Health Work in Texas

Recommendations for increasing the efficiency of state health work in Texas have been made to Governor Hobby by a special commission representing 11 state-wide organizations. It includes Charles Saville of the State Council of Defense. The commission advises that members of the State Board of Health serve for six-year terms, and that one member "be an experienced sanitary engineer"; that bureaus of sanitary engineering, communicable diseases, rural sanitation, child hygiene,

public health nursing, laboratories, and health instruction, each under "an experienced director," be created; that the state be divided into eight or more sanitary districts, each in charge of a full-time district officer; that fitness and not politics govern in filling positions; and that adequate health appropriations be made and reasonable salaries paid. Texas now spends only 5c. per capita for health protection, the special commission states.

Industrial Relations Discussed at Joint Meeting in Chicago

Safety engineering, scientific selection of workmen, and the inauguration of works councils of employers and workmen, have demonstrated excellent results at the works of the International Harvester Co., as told in an address before a joint meeting of the Western Society of Engineers and the Chicago Sections of the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers by A. H. Young, manager of the industrial relations department of the company. He stated that by safety methods accidental deaths of employees had been reduced to 7 per year, from 47 to 56 per year.

The old haphazard methods of employing men had given way to the centralized employment office, where the applicant's qualifications are carefully appraised. It now takes 3 to 3½ days to hire a man, compared with 3 min. by the old practice. By the new method the employee is made to feel that he is a real part of the organization, hired to do the particular job for which he is best adapted. Moving pictures instruct him how his work is to be done. He is also instructed specifically by the foreman, and is warned of the various dangers connected with the work.

An interesting experiment is the new arrangement which the company now has by which all matters of mutual interest are passed on by a works council, of which 50% are employees and the other half are representatives of the employer, such as superintendents. This council determines the policy and the management carries it out. In this way the men are educated in the problems of management, they see and understand the difficulties, and have already shown signs of being fair and reasonable in the problems they have had a part in solving.

Yellow Fever Eradication Work to Be Continued

Resumption of the work of the Yellow Fever Commission, interrupted by the war, is announced in a Rockefeller Foundation circular (61 Broadway, New York City). The work will be continued under Dr. William C. Gorgas, who was recently retired as surgeon general, U. S. A. Dr. Gorgas will soon sail for Central and South America, from the countries of which it is expected that yellow fever can be eradicated.

Engineers Club Reports on Cement Prices

Committee of Duluth Society Recommends That Further Study Be Left to Labor Department

Some weeks ago the Duluth Engineers' Club appointed a committee, with Lyonel Ayres as chairman, to report on the reasonableness of the prices for portland cement. The committee's report, verbatim, is given below:

The following are the prices of portland cement net f.o.b. Duluth, from 1913 to 1919:

1913	$1.55
1914	1.50
1915	1.41
1916	1.56
1917	1.91
1918	2.01
1919	2.20

This range of prices shows an increase in 1919 of 56% over 1915 price.

From data obtained from the Universal Portland Cement Co., they contend that the cause of the increase in cost of production in 1918 over 1915 is approximately as follows:

Labor	127%
Fuel	115%
Mill overhead	110%
Packing and loading	167%
General expense	49%
Care of empty sacks	62%

Quoting further from their statement, the increase on certain classes of skilled labor ran as high as 146 per cent.

In comparison with other commodities used in construction work, we find that there have been the following increases:

Gravel	36.40%
Sand	56.25%
Crushed rock	50.00%
Brick	23.10%
Lumber	70.50%
Labor	100.00%
Teams	60.00%

These figures were obtained from records in the engineer's office of the City of Duluth.

In this regard we quote from bulletin of Mar. 4, 1919, issued by the United States Department of Labor Information and Educational Service, as follows:

"At the close of the war the index number of building materials, not including steel, had risen only 61% over the pre-war prices of 1913, while the index number for commodities, exclusive of building materials, have risen 113%. The average increase of wages in the construction industrial in 41 leading cities from 1914 to 1918 was only 28.5%, as against the rise of 94% in commodities."

From the foregoing data it would appear that the increased price of cement has not been proportionately greater than the average increase on other building materials.

Your committee with the time allotted has not attempted to go into a study or investigation of the cost of cement production. Furthermore, we do not believe that a production cost can be determined during the present chaotic industrial conditions without the full coöperation of the manufacturers. Likewise, we do not believe this society is in position to delve into the trade secrets of any business organization so long as there are other means for such investigation.

If the club decide to investigate further into the cost of production, we would respectfully recommend that they refer the matter for full investigation to the United States Department of Labor who are investigating the various conditions that would enter into a revival of the building activities.

Erie Mill Creek Work to Proceed

Active prosecution of the Mill Creek flood-protection work at Erie, Penn., where a concrete conduit is being built to carry the flow of the creek through the city, is about to be started. A report on the urgency of resuming construction was made last week by the superintendent of streets. The approval of the mayor and of civic bodies supported the proposal, and the City Council voted to carry the project through at once. A bond issue of $600,000 is needed to complete the work, which, with a balance of $400,000, should suffice to carry the project through. At present the conduit is completed to 19th St.; the work to be undertaken comprises two contract sections, one extending north from 19th St. to 9th St., and the other thence north to the Pittsburgh & Erie culvert.

New Secretary for Federal Trade Commission

Following the recent resignation of Leonidas L. Bracken, who has left the Federal Trade Commission to resume the practice of law, J. P. Yoder was appointed secretary. Mr. Yoder left the commission in February, 1918, being commissioned a captain in the Army Sanitary Corps. He has recently returned from service in France.

Prior to his former connection with the commission, Mr. Yoder was manager of the Washington bureau of one of the large press associations.

Research Council Gets Funds

The Rockefeller Foundation is to appropriate $500,000 to promote fundamental research in physics and chemistry, the money to be used to support research fellowships over a period of five years and to be administered by the National Research Council. It has announced that the board named by the council to control the work consists of H. A. Bumstead, Simon Flexner, G. E. Hale, E. P. Kohler, R. A. McMillikan, A. A. Noyes and W. D. Bancroft.

Platform Collapses at Ship Launching

At least four men were killed in an accident that marred the launching of the steel vessel "Waukau" at the yard of the Merchant Shipbuilding Corporation, Harriman, Penn., Mar. 31. Workmen crowded on a patrol walk passing behind the stern of the ship next to the "Waukau," and a few minutes before the launching the walk broke down, throwing a score or more of persons into the water.

Hearing on Engineers' Pay

(*Concluded from page* 742)

Willard Beahan, chairman of the conference, spoke on the increased cost of living, which he estimated to be fully 50%, while the engineer's salary in his opinion had not advanced more than 30%, but from a point long out of line with normal increases. Then for two days W. C. Bolin, chairman of the subcommittee which gathered the data for the original schedule, presented the concrete case for those positions which the board considered within its jurisdiction: Tapeman, rodman, instrumentman, tracer, junior draftsman, draftsman, leading draftsman or designer and engineer inspectors. Higher positions having supervisory duties are handled by the regional directors. As a matter of record, however, the board asked that the whole schedule be filed. Into the record was read part of the article on "Pay and Position of Engineers in Railway Service," by C. W. Baker, in *Engineering News-Record* of Jan. 30, 1919, p. 228, and also the calculation of the cost of an engineering education, with the deduction that an engineer should receive at least $75 per month more than a skilled mechanic in order to produce and educate for the world's service another engineer.

Normally, the board will require 60 days to investigate the question and get in reports from the regional directors, after which it will take 30 days in which to prepare a report. It may be said that the board seemed to listen to the pleas with friendly interest.

Oregon Reclamation Bills Go To Referendum Vote

Subject to referendum approval, the Oregon legislature has passed a number of bills providing for or facilitating irrigation and other reclamation work. Some $2,000,000 for reclamation and $500,000 for land settlement are included. It is hoped that the reclamation fund will be spent in coöperation with the Federal Government on a dollar-for-dollar basis. One of the measures submitted to popular approval is a constitutional amendment providing for a state guarantee of irrigation and district bonds for five years after the date of issue. Various amendments to the irrigation and drainage district laws are included in the program. The drainage district law is made to conform more closely than before to the irrigation-district law. P. A. Cupper, Salem, is state engineer of Oregon.

Bequests to Terre Haute and to Rose Polytechnic Institute

A trust fund of $100,000 to improve the sewerage system of Terre Haute, Ind., and a gift of $100,000 to buy land for a city park are among the bequests of the late William S. Rea, a wholesale grocer of Terre Haute. To Rose Polytechnic Institute, Terre Haute, $100,000 was given besides a trust fund of $50,000 to afford aid to worthy students.

One-Third Engineer Officers Discharged

On Mar. 20, 1919, 31% of the engineer officers in the United States Army had been discharged. The total number of engineer officers on Nov. 11, 1918, was 10,302. Of these 3,244 are now out of the service. The corresponding figures for other branches of the service are as follows:

Branch	On Duty Nov. 11	Discharged Nov. 11-Mar. 20	Percentage Discharged
Ordnance	5,925	2,811	47
Quartermaster	10,122	4,626	46
Infantry	85,373	39,126	46

Civil Service Examinations

For United States Civil Service examinations listed below, apply to United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

United States.—Engineer-draftsman, Apr. 22, $1500 to $1800 per year. File Application before Apr. 22.

United States.—Transitman, $100 to $125 per month, and surveyor, $125 to $200 per month, Apr. 23-24. File applications in time to arrange for examination at place selected by applicant.

United States.—Expert patent investigator, $1800 to $2400 per year, and technical patent expert, $2400 to $3600 per year, May 20.

United States.—Assistant material engineer, Bureau of Construction and Repair, from $4.48 to $6.40 and upwards per diem. No date specified. Applications should be filed without delay.

United States.—Statistician, Department of Interior, $1800 per year, May 13. Apply for Form 2118.

United States.—Junior recreational engineer, Forest Service, Denver, Colo., $1800 to $2400 per year, May 6. Apply for Form 2118.

United States.—Chief of road survey party, $1800 to $2100 per year, transitman for road surveys, $1200 to $1800 per year, highway draftsman, $1200 to $1800 per year, Bureau of Public Roads and Rural Engineering, May 29. File applications before May 29.

United States.—Highway bridge engineer, $1800 to $2100 per year, junior highway bridge engineer, $1200 to $1600 per year, Bureau of Public Roads and Rural Engineering, May 21. File applications in time to arrange for examination at place selected by applicant.

Calendar

Annual Meetings

NATIONAL FIRE PROTECTION ASSOCIATION; 87 Milk St., Boston, Mass.; May 6-8, Ottawa, Can.

AMERICAN ASSOCIATION OF ENGINEERS, 29 S. LaSalle St., Chicago; May 13-14, Chicago.

AMERICAN WATER-WORKS ASSOCIATION; 47 State St., Troy, N. Y.; June 10-14, Buffalo, N. Y.

AMERICAN SOCIETY OF CIVIL ENGINEERS; 29 W. 39th St., New York; June 17-20, St. Paul-Minneapolis.

AMERICAN SOCIETY FOR TESTING MATERIALS; University of Pennsylvania, Philadelphia; June 24-27, Atlantic City, N. J.

AMERICAN CONCRETE INSTITUTE; 27 School St., Boston, Mass.; June 27-28, Atlantic City, N. J.

ENGINEERING SOCIETIES

The Colorado Association of Members of the American Society of Civil Engineers and the Denver Section of the American Institute of Electrical Engineers held a joint meeting at the Denver Athletic Club, Apr. 9, in honor of Lieut.-Col. H. S. Crocker, supervisor of the work on the Army supply base at Brooklyn, N. Y. The work on the base was described by Colonel Crocker, who illustrated his address with lantern slides.

The Brooklyn Engineers' Club will hold a meeting Apr. 10 at which Maj. Robert Starr Allyn, U. S. A., will read a paper on "Artillery Preparation and Service with the 57th Regiment, C. A. C., near Verdun."

The Montreal Branch of The Engineering Institute of Canada will be addressed, at the meeting Apr. 17 by Phelps Johnson, G. H. Duggan and George F. Porter, who will speak on the Quebec Bridge.

The Engineers' Club of Philadelphia will be addressed by Morris L. Cooke on "The Participation of Engineers in Public Affairs," at the weekly luncheon Apr. 15.

The American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Chemical Society, the Pacific Northwest Society of Engineers, the American Institute of Mining Engineers, and the Associated Engineering Societies of Seattle were represented at a joint meeting held in Seattle Mar. 27 at which Calvin W. Rice discussed problems which engineers face in matters of society organization. After the talks by Mr. Rice and by representatives of each of the societies, there was a general discussion of the best plan for carrying out further organization of engineering societies in Seattle, to the end that centralization and closer coöperation might be secured.

The Engineers' Club of San Francisco at a dinner Apr. 3 had as a guest of honor Dr. W. F. Durand, who told of his personal experiences in France. Dr. Durand's headquarters were in Paris.

The New York Chapter of the American Association of Engineers will be

addressed at the meeting of Apr. 10 by Maj. C. R. Hulsart, Corps of Engineers, American Expeditionary Forces, who will speak on "The Engineers on the Hindenburg Line."

The Rochester (N. Y.) Society of Technical Draftsmen will be addressed Apr. 24 by Allan S. Crocker on "Power Plants," with particular reference to layouts, fuel saving, machine valuation and power-plant inventory assessment.

The Indiana Sanitary and Water Supply Association's annual meeting to be held in Indianapolis Apr. 9 and 10, as mentioned in these pages last week, will include the reading of papers on finance, rates, legislation, wells, water treatment, fire prevention, meters and war experiences. As a new law requires a regular analysis of waters offered for sale in Indiana, a model laboratory is to be exhibited. The United States Public Health Service has detailed one of its traveling laboratories to assist in creating interest in water purification and regularity of analysis.

The Western Society of Engineers held a meeting Mar. 31, devoted to a discussion of public affairs, to which members of all technical societies in Chicago were invited. First-hand information from the engineers' standpoint was presented on the state constitutional convention, deep waterways, better city administration, city planning, housing and zoning, proposed legislation on the Public Utilities Commission, licensing of engineers, and good roads. The discussion was led by James J. Barbour, state senator; B. H. Peck, electrical engineer, Public Utilities Commission of Illinois, and Douglas Southerland, secretary of the Civic Federation.

The Iowa Section of the American Water-Works Association will hold its fourth annual meeting at the State University of Iowa, Iowa City, Apr. 16-17. J. H. Dunlap, of the State University, is acting secretary-treasurer of the section.

The Washington Chapter of the American Association of Engineers has elected the following officers: President, Harry Stevens; vice-presidents, A. Y. Ross and Clegge Thomas; secretary, E. L. Howard, Bureau of Yards and Docks, Navy Department; treasurer, O. M. Sutherland.

The Kansas City Chapter of the American Association of Engineers has elected the following officers: Chairman, J. E. Jacoby; vice-chairman, W. B. Cost; secretary, C. N. Clarke, and treasurer, S. M. Bate.

The Detroit Engineering Society was addressed Apr. 4 by William B. Stout, chief engineer, United Aircraft Engineering Corporation, New York, who spoke on the "Commercialization of Aircraft," discussing various types of machines for different service, air routes of travel, wireless control, and the necessity for municipal air harbors. The annual meeting of the society will be held Apr. 19.

PERSONAL NOTES

COL. PETER JUNKERSFELD, who recently received his discharge from the Army, has resigned his position as assistant to the vice-president of the Commonwealth Edison Co., Chicago, to become engineering manager for Stone & Webster, with office in Boston, Mass. He has been with the former company and its predecessors for over 23 years, beginning as assistant to the mechanical engineer and rising to be electrical engineer and finally assistant to the vice-president, who is in charge of the operating, contract, construction and electrical departments. As a reserve major he was called into service in June, 1917, and in a few months was assigned to the Cantonment Division, which later became the Construction Division of the Army. He received his commission as colonel a few months later. A portrait and a brief biography of Colonel Junkersfeld were published in *Engineering News-Record* of Jan. 23, 1919, pp. 208 and 209.

MAJ. F. P. ADAMS, city engineer of Chatham, Ont., who went overseas with the 186th Battalion, has returned to Canada and resumed his duties.

W. W. HUFF, who recently left the Army service, has opened an office as consulting civil engineer at 605 Gumbel Building, Kansas City, Mo. Mr. Huff was constructing quartermaster in the Construction Division of the Army and was stationed at several points on the Atlantic coast. Before enlisting in the Army he was engaged in practice as consulting structural engineer.

GRUPE & WALTERS will open offices at 204 Bee Building, Omaha, Neb., as consulting engineers in paving, sewers, water-works, electric-light plants, municipal ice plants and heating layouts. Mr. Grupe has been engineer in charge of work at Florence Field, Omaha, Neb.

MAJ. JAMES MCGREGOR, of Halifax, N. S., resident engineer of the Halifax Ocean Terminals, has returned after two years' service in the 3rd Battalion of Canadian railway troops.

C. S. OGILVIE, formerly assistant engineer of the Grand Trunk Ry., at Belleville, Ont., who enlisted with the 13th Royal Highlanders and was a prisoner in Germany for over three years, has been appointed assistant engineer for the Ottawa division, Grand Trunk Ry, in succession to H. Mowat.

A. A. SCHENCK, engineer of maintenance, western lines of the Chicago & Northwestern R.R., with headquarters in Omaha, Neb., was recently appointed assistant to the chief engineer, with jurisdiction over the lines west of the Missouri River. His offices are in Omaha.

A. J. TURNER, consulting engineer, Seattle, has been appointed engineer of the Columbia Basin Commission, to take full charge of the preliminary survey which the commission is to make before the actual work of reclamation is undertaken.

RUDOLPH E. LEE, T. A. MACEWAN and A. R. TURNBULL have become associated under the firm name of Lee, MacEwan and Turnbull, architects and engineers, Charlotte, N. C.

I. F. STERN, who since February, 1918, served with the United States Shipping Board, Emergency Fleet Corporation, as consulting engineer in the Division of Wood Ship Construction, has resigned from the service and reopened his office in the Old Colony Building, Chicago, for private practice.

R. S. BONSIB, formerly in the service of the United States Shipping Board, Emergency Fleet Corporation, has been appointed chief of the Division of Safety Engineering of the Working Conditions Service, Department of Labor.

GUSTAV RASMUS, consulting engineer, Denver, has been appointed chief of the Industrial Bureau of that city, succeeding George A. Levy, resigned.

J. B. LIPPINCOTT has returned to Los Angeles and has opened offices in the Central Building for the practice of engineering, after having been in Government service in charge of the Housing Corporation's work at Neville Island, Pittsburgh. Associated with Mr. Lippincott will be Kenneth Q. Volk and E. A. Rowe, recently discharged from the Construction Division of the Army, where they held commissions as first lieutenants.

CAPT. S. J. GARGES, Construction Division, U. S. A., construction officer, Elizabethport Proving Grounds, has received his discharge from the service and has become associated with the Franklin Contracting Co., New York City.

R. M. HUBBARD has been appointed chairman of the Texas State Highway Commission, succeeding Curtis Hancock, resigned, as noted elsewhere.

THOMAS F. GIBSON, advisory engineer in charge of reinforced-concrete construction for the Construction Division, U. S. A., has received his discharge from the service and has returned to the employ of the Corrugated Bar Co., Buffalo, as district engineer, with headquarters in Kansas City, Mo.

CURTIS HANCOCK, chairman, Texas State Highway Commission, has resigned and will devote his entire time to private business.

JAMES POSEY, consulting engineer, Baltimore, who has been engaged in war work, has reopened offices in

the Fidelity Building, with branches in New York and Washington. Associated with him is George W. Gail, Jr.

C. V. HANSEN, chief engineer, St. John Levee and Drainage District of Missouri, has been appointed highway engineer of New Madrid County.

WILLIS E. AYRES and GARNER W. MILLER have become associated under the firm name of Ayres & Miller, consulting engineers, Memphis, Tenn., specializing in road, drainage and flood-protection work.

CAPT. CHARLES B. SPENCER, Ordnance Department, U. S. A., who recently arrived from France, has received his discharge from the service and has returned to his work with the Underpinning & Foundation Co., New York City.

ELMER O. FIPPIN, professor of soil technology, Cornell University, is to become director of the Agricultural Bureau of the Lime Association at the close of the present collegiate year.

DAVID A. SEALEY, assistant engineer with the Public Service Commission, New York City, and for the past six years engineering assistant to the engineer of subway construction, has resigned from the organization and has joined the staff of the Truscon Steel Co., Youngstown, Ohio.

N. A. GILMAN has resigned as city engineer of Yakima, Wash.

H. A. SEWELL, HANS STRAALSUND and C. W. STRAIGHT have formed the Interstate Engineering & Construction Co. at Newport, Wash., to specialize in timber and reinforced-concrete structures.

A. K. GAULT has been appointed division engineer of the eastern division of the western lines of the Chicago & Northwestern R.R. and the Missouri Valley & Blair Bridge, with headquarters in Omaha, Neb.

WALTER SHEPARD, consulting engineer of the Boston & Albany R.R., with headquarters in Boston, on Mar. 1 was retired under the pension rules of the company. He served 44 years in the engineering department of the railroad. Mr. Shepard was born Mar. 1, 1849, at Dorchester, Mass., and was graduated in 1870 from Harvard University and in 1872 from the Massachusetts Institute of Technology. In June, 1872, he began his railway work with the Boston & Albany R.R. as an engineer's assistant. For a few years he was out of railway work, until in March, 1875, he returned to the service of the road. In April, 1882, he became division engineer, and in December, 1886, was promoted to the position of assistant chief engineer. From November, 1891, until May, 1908, he served as chief engineer of the road, and since that time he has been consulting engineer.

ORLANDO H. FRICK recently became district engineer of the middle district of the Chicago, Milwaukee & St. Paul R.R., with headquarters in Milwaukee.

M. K. BARNUM, assistant to the general superintendent, maintenance of equipment, Baltimore & Ohio R.R., with office in Baltimore, has been appointed mechanical engineer for the corporation.

HAROLD R. MILES, assistant engineer on the Canadian Pacific Ry., with headquarters in Montreal, has been promoted to division engineer with headquarters at Winnipeg. Mr. Miles was born at Lethbridge, Alberta, in 1879, and entered railway service in March, 1899, with the Washington County Railway Co. in Maine. The following year he was employed by the Algoma Central on location work and in 1901 he entered the service of the Canadian Pacific as assistant engineer on maintenance, with headquarters at North Bay, Ont. Later he became resident engineer of maintenance on the Lake Superior division, remaining there until July 1, 1915, when he was transferred to Montreal as assistant engineer. More recently he has been division engineer, with headquarters at Lethbridge.

W. S. GEARHART has resigned as state highway engineer of Kansas. Captain Gearhart went to Kansas from the Illinois Highway Department and established a similar department at the Kansas Agricultural College. When the Kansas State Highway Commission was created, Mr. Gearhart became state highway engineer. Last year he received a leave of absence from the state service to enter the Army engineer corps.

W. T. MAIN has been appointed division engineer of the Black Hills division of the Chicago & Northwestern R.R. and the Wyoming & Northwestern R.R., with headquarters at Chadron, Neb.

H. K. YORSTON, until recently division engineer of the Canadian Pacific Ry. at Winnipeg, has been appointed locating engineer of the Canadian Pacific, Western Lines. He is succeeded at Winnipeg by Harold R. Miles, as noted elsewhere.

OBITUARY

ALLEN T. FRASER, of Winnipeg, chief engineer of the Canadian National Rys., was killed by a snowslide near Mount Robson in the Yellow Head Pass through the Rocky Mountains, Mar. 31. The train on which Mr. Fraser was proceeding west was stopped by the slide. Mr. Fraser and a section crew went to make an examination when another mass of snow and rock came down, burying the party. The section hands were dug out alive, but badly injured. Mr. Fraser was 46 years of age and had been in the service of the Canadian Northern Ry. for many years. He was formerly district engineer of that line, at Edmonton, but in January last was promoted to the position of chief engineer of the western division with headquarters at Winnipeg.

GEORGE H. GARDEN, formerly resident in Montreal, died recently at Rouses Point, N. Y., aged 70. He was born at Woodstock, N. B., and had been all his life engaged in engineering. At the age of 20 he was appointed assistant engineer on the location of the Intercolonial Ry. and was subsequently in charge of part of the location on the Crow's Nest Pass division of the Canadian Pacific Ry. Mr. Garden afterward became chief engineer of the Alberta Ry. & Coal Co. at Lethbridge, Alta., leaving that position in 1901 to practice his profession in the East. He retired in 1914, his last work being the location of a large section of the Canadian Pacific Ry. Montreal-Toronto (lake shore) line. Mr. Garden was a member of the Engineering Club of Montreal and the Engineering Institute of Canada.

A. C. WALKER, civil engineer of Blacksburg, Va., died in that city Mar. 21 at the age of 69. A large part of Mr. Walker's life was spent in railroad location work, among which was that of the Carlisle, Clinchfield & Ohio R.R. line across the Blue Ridge Mountains. He was educated at the United States Military Academy.

OWEN BRAINARD, consulting engineer and architect, New York, died in that city Apr. 2. He was 54 years old. After attending public and private schools, he engaged in machine-shop work for two years at Haddam, Conn., and Philadelphia, and in 1887 became associated with his father in the construction of buildings and general contracting in Middlesex County, Connecticut. Continuing in contracting and architectural work, he became general superintendent and manager of the firm of Carrere & Hastings, architects, New York City, of which he became a member in 1901. In 1907 Mr. Brainard opened his own offices as a consulting engineer and architect in New York City. During his association with Carrere & Hastings he had assisted in the design of the New York Public Library, the Senate and House office buildings in Washington, the extension of the United States Capitol, and the Yale memorial buildings. His later work has been the design of the New Theater, New York City, now the Century, and the industrial villages of the United States Steel Corporation.

J. E. JOHNSON, JR., mining and consulting engineer, New York City, died Apr. 4 as the result of an automobile accident. He was a director of the American Institute of Mining and Metallurgical Engineers.

National Foreign Trade Convention To Be Held in Chicago

Announcement has been made of the sixth National Foreign Trade Convention, which will be held in Chicago Apr. 24-26, inclusive. The session Apr. 24 will deal with America's need of foreign trade, while that on the 26th will be devoted to a discussion of the American merchant marine. A variety of subjects connected with the post-war problems of foreign trade will be presented Apr. 25. Among the subjects and speakers will be: "America's Financial Equipment for Foreign Trade," by Fred I. Kent, vice-president of the Bankers' Trust Co.; "The Interest of Labor in Foreign Trade," by Hugh Frayne of the War Industries Board; "The Element of Labor Costs in American Exports," by William Pigott, president of the Seattle Car & Foundry Co.; "The Effect of Increased Productive Capacity Upon Our Foreign Trade," by Edward Prizer, president of the Vacuum Oil Co., and "The Future of Our Foreign Trade," by Edward N. Hurley, chairman of the United States Shipping Board.

Other speakers will be William S. Culbertson, of the Tariff Commission; John M. Parker, president of the Mississippi Valley Association; J. W. Hook, president of the Allied Machinery Co., of New York; James A. Farrell, chairman of the National Foreign Trade Council, and Breckinridge Long, third assistant secretary of state.

Present Claims on Cancelled War Contracts by May 15

Benedict Crowell, assistant secretary of war, has given notice that contractors desiring to adjust cancelled war contracts through the machinery set up by the War Department must present their claims prior to May 15. He stated that nearly half the claims involved had not yet been formally presented. The inconvenience caused by this delay was stated by Mr. Crowell as follows:

"This failure on the part of contractors is occasioning the department embarrassment. The organization which is handling this matter is essentially civilian in character and composed of men who remain in this work only at a very great sacrifice and at the urgent request of the department. I do not feel that I can continue indefinitely to impose that hardship, and have determined that all contractors who desire to avail themselves of the existing organization for the settlement of their claims must present them prior to May 15, 1919."

Cement Price Is Lowered Throughout Country

There has been a general decline in the price of cement, amounting to from 5c. to 15c. net, 65c. to 75c. gross. The charge for sacks has been decreased 40c., or from $1 per bbl. to 60c. A statement of the situation is to be issued by the cement manufacturers Apr. 10.

Ditcher Arranged to Cut Close to Obstructions

A new mechanical ditcher, designed to cut trenches close to buildings, curbs, pole lines and other obstructions, has been designed by the Pawling & Harnischfeger Co. The machine, which is shown in the accompanying illustration, has corduroy grip tractions, and will cut a trench from 15 to 24 in. wide to a maximum depth of four feet.

Three changes of speed are made available by sliding gears without changing sprockets, so that quick changes can be made to suit the character of the material being excavated. By means of two sizes of chain sprockets a total of six speeds can be obtained, ranging in geometrical progression from about 1.5 to 5 ft. per minute.

DITCHER IN OPERATION NEAR WALL

Although the standard width of cut is 15 in., adjustable side clearance cutters enable the machine to dig 24 in. The corduroy grip tractions are of unequal width, a 19-in. width being used under the cutting side to take up the extra weight, while 15-in. width is used on the other side. Power is furnished by a 25-hp., four-cylinder vertical engine of the tractor type, arranged for burning kerosene, gasoline, or motor spirits. The various dimensions are: Width over all, 10 ft. 7 in.; length over all, 25 ft. 9 in.; height 9 ft. 7½ in.; total weight 19,500 pounds.

BUSINESS NOTES

The Allied Machinery Co. of America announces the removal of its main offices in New York to 51 Chambers St., where it will occupy the entire eighth floor. This company is a subsidiary of the American International Corporation.

The Chicago Pneumatic Tool Co. announces the discontinuance of its office at Wichita, Kan., and the establishment of an office and warehouse at Eldorado, Kan. A new office has also been opened at Tulsa, Okla., at 313 Richards Building, with warehouses at 102 North Cheyenne St. It is thought that this arrangement will better serve the territories concerned.

The American International Steel Corporation announces that Lieut. Col. Merrill G. Baker has been appointed president of the company, effective Apr. 1, 1919. Colonel Baker was formerly assistant general manager of sales for the Cambria Steel Co., but has been in the Ordnance Department since shortly after America entered the war. He succeeds the late Edward M. Hager, who died over a year ago, since which time Morris Metcalf, vice-president, has been in charge of the business. Mr. Metcalf will remain in his old position. The American International Steel Corporation is a subsidiary of the American International Corporation and is engaged in the exportation of steel products and railway equipment.

The Bucyrus Co. has opened offices in Minneapolis, from which point it is intended to serve the Northwest district to and including Nebraska.

The Ideal Engine Co., of Lansing, Mich., manufacturer of power equipment, announces that it has added H. H. Lucas to its sales force. Before joining the United States Navy, Mr. Lucas was with the Lansing Co. Mr. Lucas will take up his duties early in April, after his discharge from service.

TRADE PUBLICATIONS

"Checking Thermocouple Pyrometers" is the subject of bulletin No. 867-B, issued by the Leeds & Northrup Co., Philadelphia, Penn. This is an 8 x 10½-in. 23-p. pamphlet covering heat-measuring apparatus and is illustrated with half tones and line cuts.

The Quigley Furnace Specialties Co., 26 Cortlandt St., New York, N. Y., has issued bulletin No. 11, covering the preparation, distribution, and burning of powdered fuel, using the company's air transport system. The bulletin is 8½ x 11 in.; has 15 pages, and is profusely illustrated.

The Page Steel & Wire Co., of 30 Church St., New York City, has just issued a 4 x 6½-in., 60-pp. pamphlet, which deals with Armco iron rods and wire for oxyacetylene and electric welding.

"Absolute Permissive Block-System Circuits" is the title of a new bulletin issued by the General Railway Signal Co., of Rochester, N. Y. The booklet consists of 16 pp. 6 x 9 in. in size, and is illustrated with half tones of signaling apparatus. It contains an insert of seven pages of block-system circuits.